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The Mandalorian
#263

THE CHILD
Blending puppetry
with CG



37

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ISSUE 263

THE MANDALORIAN

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ACCESS AS **ILM** DISCUSS A
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INDUSTRIAL LIGHT & MAGIC

ILM have a long and illustrious record in VFX but they are linked most closely with the *Star Wars* universe. This issue we take you behind the scenes on their latest project, *The Mandalorian*.





EDITOR'S

WELCOME

The VFX of *The Mandalorian*



It's fair to say that the first half of 2020 has been a little unusual. What with lockdowns caused by the global pandemic, and the Black Lives Matter movement, things are in a moment of flux.

What that means for us as a community of 3D and VFX artists is yet to be seen. Clearly the schedules of most, if not all, studios have been heavily impacted, with many productions stopping entirely. Other studios have flourished however, with new opportunities arising from turmoil.

Some of you may already work from your homes or small studios, others may work as part of larger facilities and now find yourself at the dining room table. The jury is still out on whether the end result of all this change will benefit anybody, and if so who, but we are keeping our ear to the

ground and if we learn anything we will be sure to share.

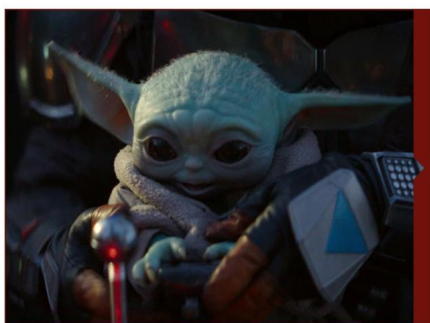
As for the BLM movement, we are taking a long, hard look at ourselves, as well as what and how we commission. We didn't want to take a blind step in any direction, but it's clear things need to change. I'll use this space to update you all very soon, but I cannot agree more strongly with the statement that Black Lives Matter.

Rob

Rob Redman, Editor
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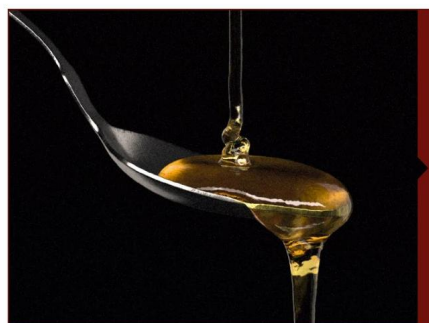


SPOTLIGHT ON OUR CONTRIBUTORS



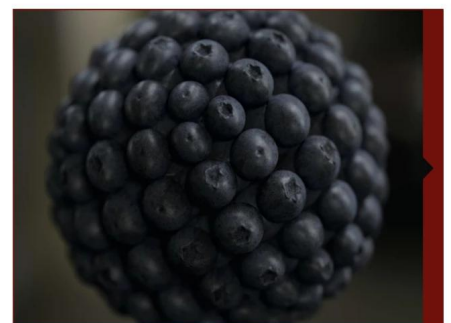
James Clarke

3D World regular and VFX veteran writer James Clarke returns this issue to explore the wonderful work of ILM.



Holly Watt

Holly uncovers the mysterious workings of Bifrost for Maya in her in-depth tutorial, starting on page 48.



Matthew Novac

Matthew takes you step by step through the process of creating stunningly photorealistic CG fruit.



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CONTENTS

ARTIST SHOWCASE

8 The Gallery

Discover the best digital art from the CG community

80 Technique Focus:

Dave Miragliotta showcases his stunning 'Cave Ritual' image

FEATURES

20 The Mandalorian

ILM give us the lowdown on the hugely popular *Star Wars* show's amazing visual effects

32 The Idea Factories

How can CG software and technology benefit the world of automotive design?

38 BMD Fusion tips

Master this compositing software with this handy collection of top tips from the experts

THE PIPELINE

48 Simulate small-scale liquids in Bifrost

VFX artist Holly Watt details how to create realistic liquid in Maya

56 Subdivision modelling in Gravity Sketch

Glen Southern dons his VR headset for some creature design

64 Create blueberries procedurally

Replicate natural patterns with CG supervisor Matthew Novak

70 Produce a warm atmosphere

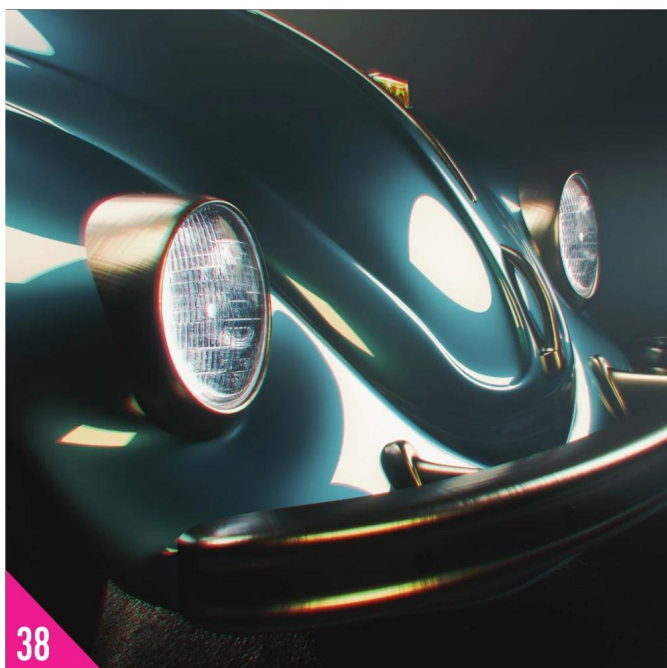
Amir Mohammad Nabavi shows how to create a warm interior

ARTIST Q&A

74 Your CG problems solved

Pro artists tackle your queries

20



38

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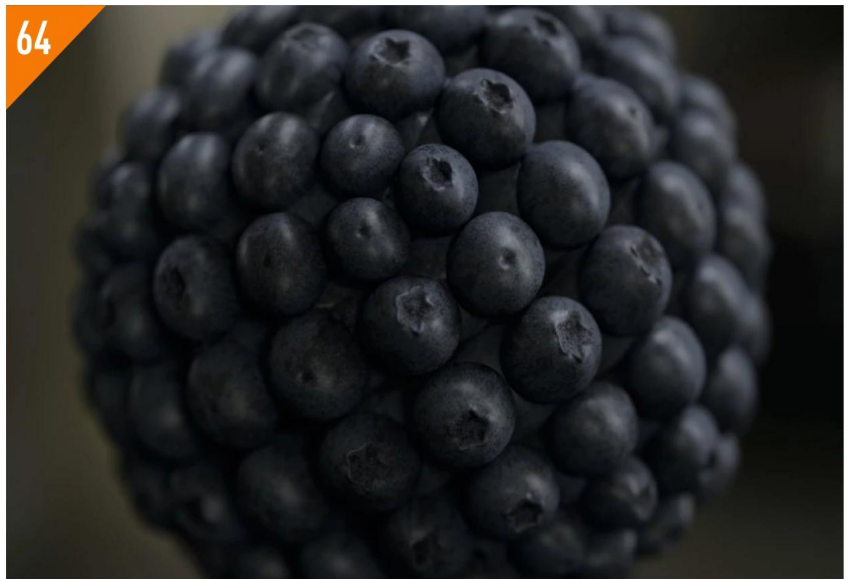
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ONE OF THE GREATEST EVER CHALLENGES I'VE FACED IN THE VISUAL EFFECTS INDUSTRY

Richard Bluff, VFX supervisor, *The Mandalorian*



64



70



82



90



THE HUB

82 A New Domain

We take a look back at the *Apollo 13* movie as NASA marks the 50th anniversary of the mission

86 Sculpting celebrities

Discover the striking work of CG artist Hadi Karimi, who creates photoreal celebrity likenesses

90 Mediatonic: growing a creative games company

Game director Ed Fear discusses Mediatonic's latest projects

94 Day in the life

Industry veteran Ant Ward shares how he spends a typical day as a freelance generalist

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The Gallery

The best digital art from
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HEIST AT THE REFINERY



ARTIST
Col Price
SOFTWARE
3ds Max, Mental Ray,
Photoshop

This dynamic scene only took freelance art director and concept artist Col Price a few hours to complete. "I just like to sling stuff together when it's my own work," says Price, "it's more about the action and story than anything else."

"The ship is a simple model," he explains. "I don't use normal maps or anything. It's all lit with one light source. I always prefer to do this, it gives me a better lighting pass and lets me add colour to the shadows. That way I can paint on the image in Photoshop, adding extra textures and details."

The explosion elements were made using an assortment of photographs taken by Price, mostly of fireworks. The reflections are taken from pictures he snapped on rainy days. "The action elements are always the fun part," he continues, "explosions, sparks and getting some energy and dynamic composition is always fun to do. I like to try and make images feel cinematic and kinetic."

● [instagram.com/coldesign](https://www.instagram.com/coldesign)







EMBER



ARTIST
Sina Pahlevani
SOFTWARE
ZBrush, Maya,
Arnold, XGen

Character artist Sina Pahlevani worked on this image every day after work, completing it in around ten days. Rather than undertaking extensive planning, Pahlevani likes to develop his artwork throughout the process. “Most of the time I don’t have a clear image in my mind, I just define the main story of my artwork. I might change things a lot during the process.”

First, Pahlevani blocks out the character’s shape and silhouette in ZBrush. The second stage is adding further detail and enhancing the shape of the character, before it undergoes

retopology, UV and texturing. “I do retopology and UV in Maya,” Pahlevani explains. “For the texturing part you might use Mari, Substance Painter, or ZBrush Polypaint.” The final stage of the pipeline involves setting up the shaders and lighting the scene, before making early test renders in Arnold. “After you get the first result you need to go back and forth to modify your model,” Pahlevani continues, “using textures and shaders to achieve your desired result.”

● artstation.com/sinapahlevani

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MORRIGAN



ARTIST

Ed Pantera

SOFTWARE

3ds Max, ZBrush, Substance Painter, Marvelous Designer, Mari, Maya, Arnold, XGen, Photoshop, TopoGun

Character modeller Ed Pantera wanted to recreate his favourite female characters from fighting video games. “I made Cammy from *Street Fighter* last year,” he explains, “then I planned to make Morrigan from *Darkstalkers*.” It took Pantera four months to create Morrigan in his spare time.

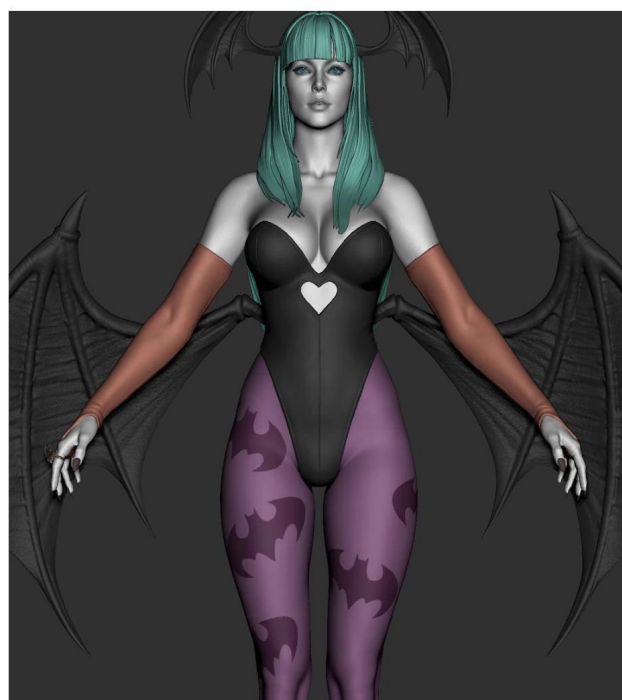
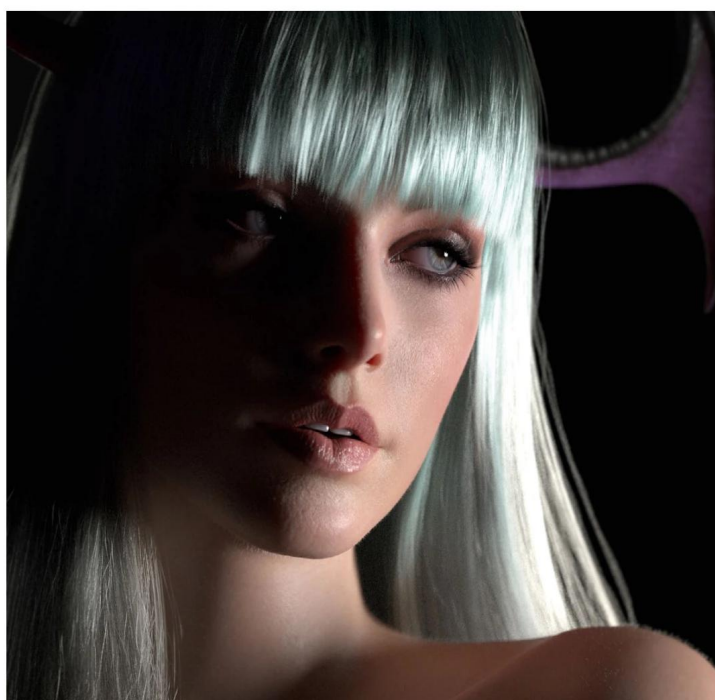
Substance Painter was used for the majority of textures, with Mari and Texturing.xyz maps helping to create the realistic skin.

Much of Pantera’s inspiration also comes from his favourite films, the likes of *Star Wars* and *Blade Runner*. “I like movies that are full of imagination and nostalgia,” he explains. “If I am touched by a character after watching the movie, I start to make something. 3D technology is so developed now, there is very little technical restriction to express something that I imagine.”

Patience is key to problem solving in Pantera’s workflow. “If I face some

technical difficulty, I take a short break and then try again,” he adds. At one point, this meant upgrading his computer when XGen couldn’t complete the render. “I have a study group that work together,” he continues, “the members help each other a lot. I would like to take this opportunity to thank Groten and Gunnart for their helpful comments.”

● [instagram.com/ed_pantera_3d](https://www.instagram.com/ed_pantera_3d)





WATER GUN



ARTIST

Tim Curry

SOFTWARE

3ds Max, ZBrush, Substance Painter,
Photoshop, Marmoset Toolbag

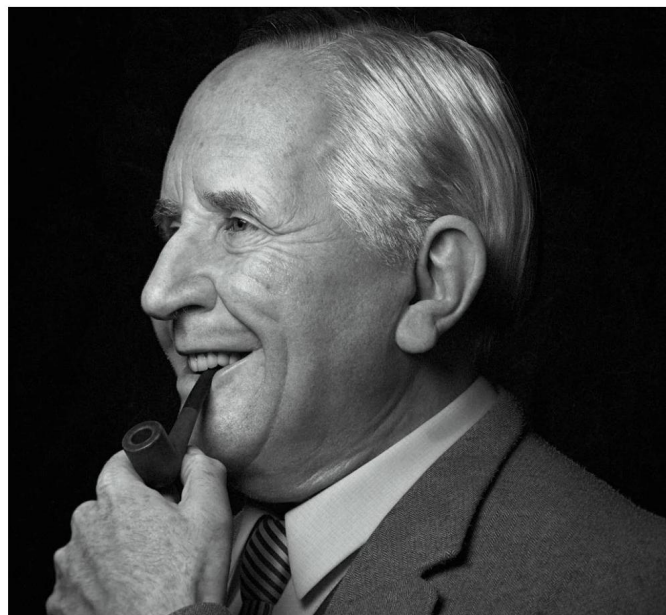
Video game artist Tim Curry has worked in game development for eight years, taking on numerous job titles and responsibilities. “Making props is one of my favourite things about game art,” he adds.

Many of Curry’s usual techniques were utilised on this piece. “The most noteworthy technique used was one I learned from Ranulf Busby,” he continues, “who shared how to use parallax in Marmoset Toolbag 3 to simulate the reticle movement of a holographic sight. It was very satisfying to see it work as I expected.”

Finding a technical aspect with which to push forward his work is crucial to Curry’s approach. “I really like finding something technical to do, even if it’s small,” he adds. “For this project, it was just the parallax reticle, but I also enjoy simple rigs and animations. I’d like to utilise real-time effects more in the future. While I was working on Water Gun, I thought about how I would animate it for a first-person game. How would you reload it? If I was to revisit, I’d like to experiment with creating animations like that.”

● tcurry.artstation.com





PORTRAIT OF J.R.R. TOLKIEN



ARTIST
Roger Magrini
SOFTWARE
ZBrush, Maya, XGen, Substance
Painter, Arnold, Photoshop

It took character artist Roger Magrini three months to complete work on this lifelike recreation of *The Lord Of The Rings* author J. R. R. Tolkien. "Everything was hand-sculpted and Polypainted in ZBrush on HD Geometry," Magrini explains, "except for his pipe, I used Substance for that." Magrini often uses his artistic experience to create 3D cartoon characters, but he also enjoys the

challenge of photorealistic portraits such as this. "I enjoyed most of the process on this," he says, "but the best part was creating his smile."

Magrini began by gathering as much reference as possible, all with different angles and lighting setups. "Likeness is like a puzzle," he adds, "so you need reference to fill in the gaps." Magrini sculpted the likeness in ZBrush, before adding skin details by hand, using

brushes he created. "Then I Polypaint the Albedo, Specular and Bump maps," he continues.

Magrini challenged himself to achieve photorealism from the very first render, without any post-processing. "I also like to do a stress test in different lighting setups," he adds, "to see if things hold up."

● artstation.com/rogermagrini

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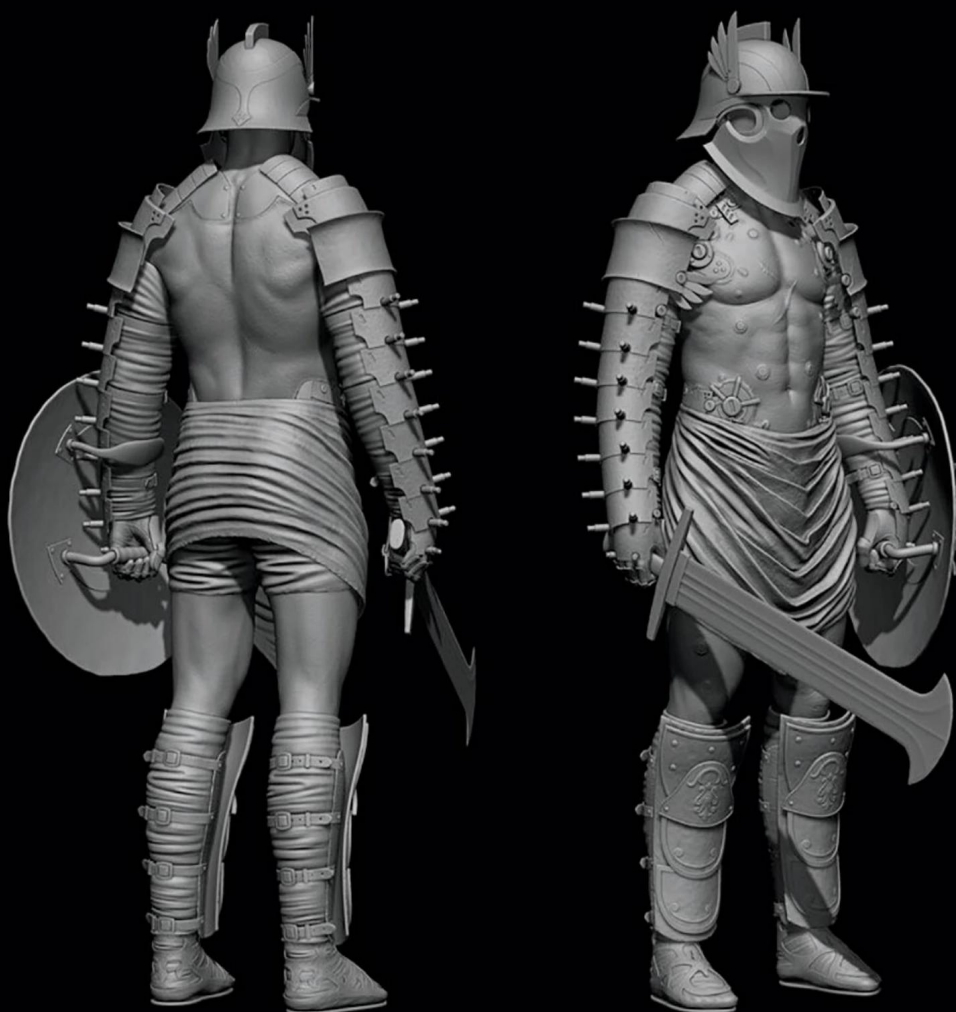


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SPACE GLADIATOR

YEAR CREATED 2019 **SOFTWARE** Maya, ZBrush, Mari, Substance Painter, Substance B2M, V-Ray, Photoshop, Nuke

I created this character to develop a better understanding of the character pipeline for cinematics/film, and to learn Mari. Also, the concept was painted by the legendary Ariel Perez; I had wanted to translate one of his pieces to 3D for a long time.

● alec2002.artstation.com



ARTIST Alec Hunstad
LOCATION United States
 I'm a character/creature artist and just graduated from Gnomon. I recently started my career at MPC and couldn't be more excited to see what the future holds.



THE MANDALORIAN

ILM DISCUSS A BOUNTY OF VISUAL EFFECTS



sits down for a conversation with Richard Bluff, visual effects supervisor and Hal Hickel, animation supervisor, both at ILM in San Francisco, to unpack the creative adventure of telling the story of a galactic bounty hunter.

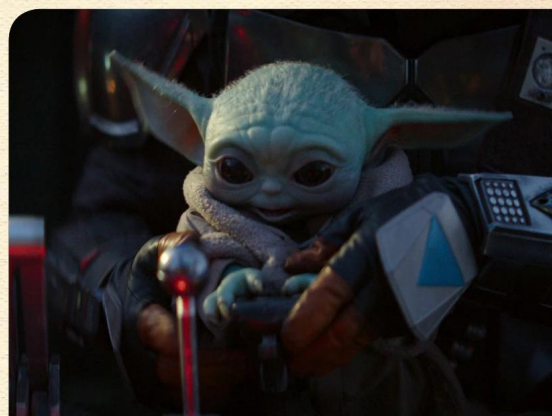
Werner Herzog, world-renowned filmmaker and occasional actor, takes a key role in the new *Star Wars* TV series *The Mandalorian*. Speaking in 2019 about the series, Herzog made the key point that it deploys what he described as mythic images, and his description speaks to the visually compelling quality of the series and the rich tradition of *Star Wars*. It's a pop-culture phenomenon that has captivated the imagination in two ways: the story unfolding on screen, and also the story of the creative impulses, choices and challenges to put those stories in motion.

Richard Bluff begins our conversation by identifying the project's landmark approach to environment creation: "I think the biggest challenge was wrapping our head around how we wanted to utilise real-time game technology in collaboration with the LEDs, effectively prototyping out what that technology would look like, and then of course executing a production-ready tool for the first day of shooting. That was by

far and away one of the greatest ever challenges that I've faced in the visual effects industry."

Fascinatingly, ILM has a connection to game engine use that dates back to their work on Steven Spielberg's dazzling science-fiction fairy tale, *A.I. Artificial Intelligence*, where it was used for virtual production approaches during filming of the Rouge City sequence.

Bluff sketches out the long-standing relationship between ILM and its use of LED: "There had been an awful lot of work done prior to *The Mandalorian* utilising LED screens at ILM and Lucasfilm: they'd been used on *Rogue One* for example, and the game engine technology, particularly Unreal Engine for season one, had been used extensively for X Lab, our immersive development department at ILM, on various augmented reality and VR projects. So, there were various pieces of all of the pipeline that had been utilised in visual effects, or with Jon Favreau [series creator] and his past projects including *The Lion King* and *The Jungle Book*. I think the biggest challenge was pulling all of that together, but more than that it was the goal that we set ourselves of shooting half of the season in the LED volume, and within that amount of work making sure above 50 per cent of every take would constitute an in-camera final. And, as a >





A practical set piece of the Razor Crest cockpit positioned in the StageCraft volume for real-time interactive lighting

➤ result, that would have meant us building over 110 real-time environments that in theory had to be photoreal and played in-camera. There was nothing that existed prior to *The Mandalorian* that had attempted anything near what we tried to do. Up until now it was isolated to one or two shots or scenes with content that was intended as previz only for dynamic lighting, whereas we were attempting in-camera set extensions – effectively taking the post-production aspect and putting it in prep.”

Bluff goes on to offer context for ILM’s work in applying the game engine technology to their production and visual effects collaboration: “ILM has

a rich history of projects, plus supervisors and artists working in new media. Prior to Kim Libreri joining Epic he was a visual effects supervisor at ILM and had been the lead supervisor behind an ambitious project to turn a video game environment (that was never used), and try to imagine how we could utilise that world and those characters and use it in a real-time game engine to generate content. So, he’d already been pursuing game engines for television or theatrical content for a long time.

“The same goes for various artists – take Landis Fields, he and I had worked on the Millennium Falcon Smuggler’s Run ride [for Disneyland] a year

or two prior to *The Mandalorian* starting, and the list goes on in terms of the projects that various folks at ILM had been involved in, so I think people saw that this was a possibility on the horizon. There were few people that saw the link with the LEDs. We were also pursuing game engines as a back-end post-production renderer to see what leverage we could get out of there. But this was certainly the project that pulled all of those ideas together and it goes without saying that without Jon Favreau, his vision and his thorough understanding of the technology, we wouldn’t have done what we did. Various pieces of this tech have existed for a long time, but there’d never



Kuiil rides a blurr mount (to be integrated with animated CG blurr in wide shots) towards the Razor Crest in the StageCraft volume for real-time interactive lighting

been a filmmaker that ILM and Lucasfilm had come across since George who was so willing to put the entire project on a theory behind what we could do with technology. And for Jon it was his 'Holy Grail' shooting methodology that would allow him to reduce the stage footprint, maintain the project in LA as well as increase the speed of production, while advancing the technology and giving his actors, directors and DP something to shoot against aside from just green screens."

The Mandalorian offers us new characters, sometimes seen in familiar settings, including the desert planet of Tatooine (the planetary lynchpin of a galaxy far

"WE HAD TO GET OUR CG VERSION OF THE BABY ALIGNED WITH THE PUPPET"

Hal Hickel, animation supervisor, ILM

far away): "One of the interesting things about Tatooine of course is that it's incredibly iconic, and knowing that we were going to go back there everybody was very sensitive to the fact that we wanted to put it in the best light possible. Because we were styling the show on a Western, and we were mimicking a lot of the aesthetics of the original movies, we actually felt that it

was important to show those same locations when we arrive at Tatooine. So, for example, when we arrive at Tatooine and the Razor Crest flies in towards Mos Eisley there are two establishing shots, and so we actually went back to the archives at Skywalker Ranch and pulled out the original matte paintings and rephotographed them digitally to use them



➤ again in the show. One of them, we weren't able to get the kind of resolution that you'd expect these days, so we tracked down the real location, in Death Valley, where the high angle was shot and we rephotographed elements of that. We worked it back into the original matte painting to increase the resolution and enhance what was already there to ensure that it would hold up for today's viewing.

"And then the second thing I would add was the Mos Eisley cantina, which of course is a very iconic environment that everybody's very familiar with,

Above: The Razor Crest miniature built and photographed for season one of *The Mandalorian*

Opposite:
Digital double of
The Mandalorian

Below: John Knoll prepares a shot of the Razor Crest, adjusting the bounce light onto the model

and it was an environment that Jon Favreau felt very strongly we should try and put on the volume. But it was an environment that presented some very unique challenges because the actual bar itself is very small, so therefore it would only take up a third of the volume itself. So, we had to slide our physical set over to one side of the volume, so when one angle across the bar is all LED, we had to make sure [the LED] was at the correct depth to maintain the right sort of focus. But it also meant that if you did a reverse to the right of the physical booth where Tora was sitting, the actual booth extension was another 30 feet back on the opposite side of the LED screen. So, this presented some very unique problems

with focus of course: we knew we couldn't present something that was anything less than what was there in *A New Hope*, and because we're using this new technology as well we couldn't show our hand. It had to be perfect as far as we were all concerned. So that was a scene that we pre-vizzed to within an inch of its life, so that we knew exactly where the camera was going to go in every single setup. [We had to] make sure that the camera field of view saw exactly what was intended to ensure that any blending between the physical and the LED matched perfectly. I'm happy to say that it went wonderfully well due to the collaboration between the DP, the production design, construction and visual effects to

"WE TRACKED DOWN THE REAL LOCATION IN DEATH VALLEY AND REPHOTOGRAPHED ELEMENTS"

Richard Bluff, visual effects supervisor, ILM



the point where every single shot of the environment within that scene is all in-camera: LED and physical set. The only additional visual effects that were ever done in that scene were the addition of the hologram on the table and painting out the puppet rods for the bartender. That was it."

Since its inception, *Star Wars* on screen has always fused live action with forms of animation: stop motion, cel animation and animation rendered using digital technology. *The Mandalorian's* animation ethos draws together all of these approaches. Hal Hickel notes that, "One of the big challenges on the show was the diminutive character known only as The Child. And at that point in time, Legacy was still building and finishing the puppet. And while they were doing that, we were building the CG version and because of scheduling, both of those things had to happen kind of at the same time. And we also



HAL HICKEL ON... IN-CAMERA MAGIC

"It gives creative control back to the filmmakers because they can see the world that they're interacting with. It's not a sea of green anymore.

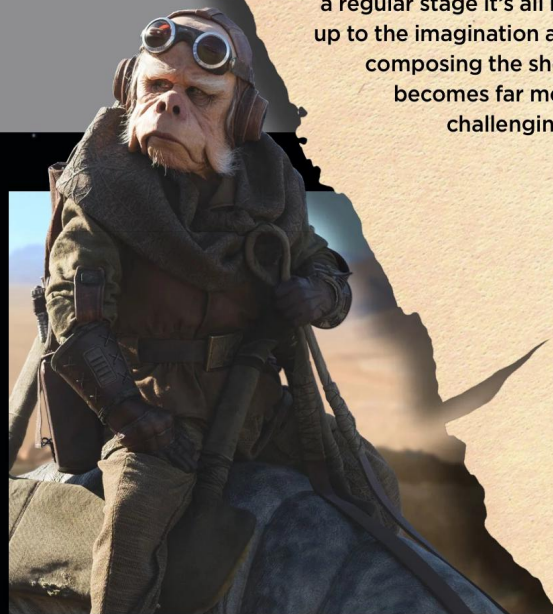
It's hard for me to imagine now because I've been involved with this technology for two-and-a-half years now. The idea of going back to a set that is bathed in green and the idea that the DP is trying to second-guess what this environment is going to look like from a single piece of concept art, it seems crazy now. Even when we shoot on our backlot we have greenscreen backing there because we're back up against a railway yard (in LA) and we're outside, but it's very frustrating considering that the previous day we may have been on the volume where we could see the vista, we could see the set extension, we could see the spaceship parked off in the distance or the creatures walking over the brow of the hill. Whereas when you're on the backlot or on a regular stage it's all left up to the imagination and composing the shots becomes far more challenging."

didn't know yet how much the puppet would play. We thought, it might be like some shows where the puppet ends up being really good lighting reference and we end up replacing it. Or it could be the other extreme, and it turned out to be the other extreme, where the puppet plays most of the time and does the heavy lifting and our job was to match it really well; so, that was the main thing when I came on. That was the hot item: to get our CG version of the baby aligned with the puppet, and really kind of figure out how to animate it so that it still felt like the puppet even when we were doing all-CG shots.

"So, that was the big thing and it grew from there as I got involved with more and more of the work, and ultimately I supervised all of the animation work. As I said, the main focus when I first joined was getting the baby right, and then we went

on with the Mudhorn, IG-11, pit droids, Jawa, sandcrawler, TIE fighters etc. Basically, everything you expect in *Star Wars*."

Hickel then details the work of his team on contributing to the creation of The Child (the diminutive and mysterious character that The Mandalorian is charged with bringing in). "In terms of the handshake between CG and puppeteering, The Child is a really good character to focus on because while the puppet plays in the majority of shots there's still a whole range of CG participation. [There are times when] it's basically the puppet and we've just nudged an expression slightly or adjusted the facial a tiny bit, or given the fingers a little more movement. Then the next step up might be some shots where we might do a head replacement: we keep the real body but replace the head with CG, because later in editorial we might really need a



Above:
Kuiil rides the blurrig across the desert. The environment is realised using a wrap-around LED screen

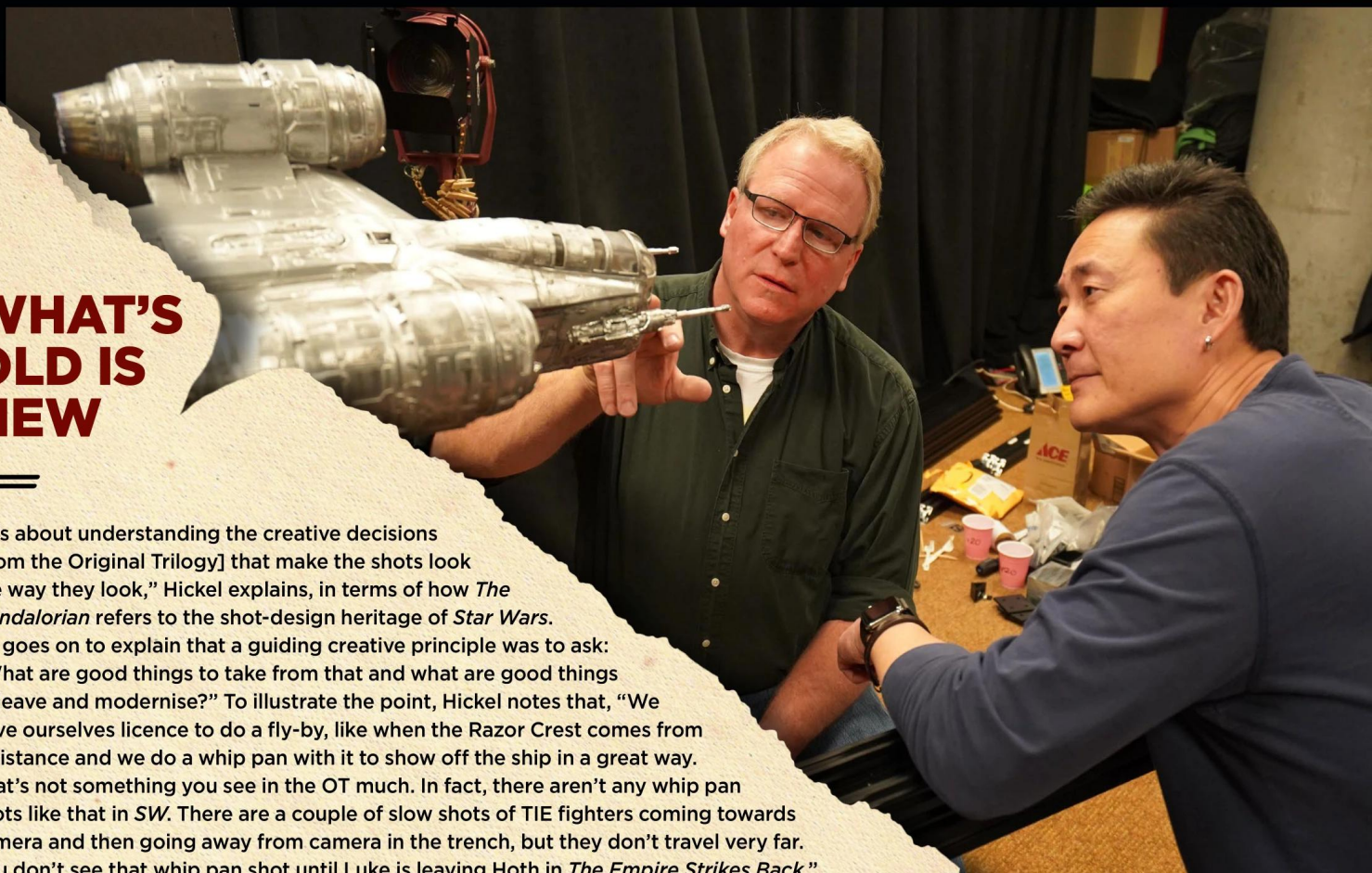
slightly different reaction than what we got on the day and so we need to change it. And again, even then, we would make sure we animated the head in a way that was consistent with what the puppet could do. And then there's shots where he's completely CG, from head to toe, and those typically were shots where he was active or walking in a way that was a little hard to get with the rod puppet or the

The Mandalorian and The Child in the cockpit of the Razor Crest



WHAT'S OLD IS NEW

“It’s about understanding the creative decisions [from the Original Trilogy] that make the shots look the way they look,” Hickel explains, in terms of how *The Mandalorian* refers to the shot-design heritage of *Star Wars*. He goes on to explain that a guiding creative principle was to ask: “What are good things to take from that and what are good things to leave and modernise?” To illustrate the point, Hickel notes that, “We gave ourselves licence to do a fly-by, like when the Razor Crest comes from a distance and we do a whip pan with it to show off the ship in a great way. That’s not something you see in the OT much. In fact, there aren’t any whip pan shots like that in *SW*. There are a couple of slow shots of TIE fighters coming towards camera and then going away from camera in the trench, but they don’t travel very far. You don’t see that whip pan shot until Luke is leaving Hoth in *The Empire Strikes Back*.”





➤ **physical puppet:** like when he's at Kuiil's ranch and the baby is chasing after a frog, shots like that. I love characters where we are grounding them in something that's real and we're partnering with the brilliant folks at Legacy to create this thing. Again, the audience feels like it's a real, physical thing, but occasionally we can push it in ways that were hard to get with the puppet. In this case, the last ten per cent of the overall presence in the series was the CG part.

"When we were designing, if the eyes [of The Child] had too much sclera, or too much white in the eyes around it (which is something ordinarily that you'd want on a character), Jon was like, 'I don't really want to see very much. A little tiny sliver's okay, but those big dark eyes look more animal almost', and that to him was better. That was surprising because my tendency, because I partly come from an animation background, was to say, 'Let's have a nice clear sclera so we have really strong eye direction', but Jon said 'No, let's not.' I learnt a lot from him."

For the series, Hickel and his team moved back and forth between animation and on-set puppetry, and he uses the example of the droid IG-11 to illustrate the relationship: "With IG-11, we had an actor on set in a grey suit but the intention wasn't to capture his movements, he was there to indicate eyeline and give the actors something to react to and play off of. We had a physical mock-up build of IG-11 from the waist up and it was really intended as lighting reference, but it looked great so the puppetry team rigged the arms up with some rods and the puppeteers could do basis stuff with him in close-ups. So, while the vast majority of shots are CG, there are a handful of shots where we're using the physical, puppeteered mock-up.

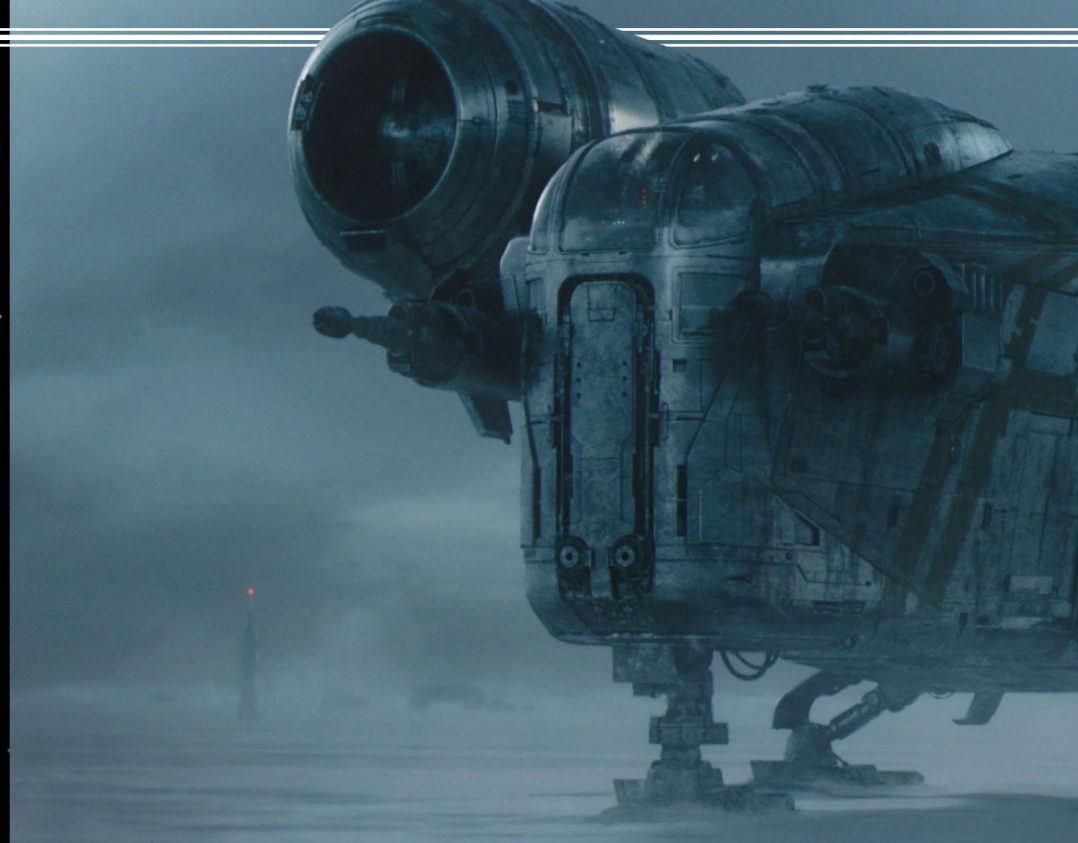
"And then IG-11, because of his peculiar design we didn't want to go with mocap. We thought that it would be boring to have such an outrageously skinny and rectilinear kind of tin robot design and then to ➤



Digital version of The Child for animation

➤ just put naturalistic human motion on him didn't seem right. So, he's 100 per cent keyframed and the work for this was led by Ken Steel, animation supervisor at Hybrid that led the charge on the IG stuff. ILM did some IG shots as well, but Ken's group really defined his style of movement and so we had a lot of conversations about how he's kind of like a tin robot, kind of stiff and comical in that way. But once he starts shooting, because he's got eyes and sensors all over his head, he can shoot in any direction at any time. And we definitely wanted his body to do things that humans couldn't do in terms of how the arms are operating and the torso can swivel 360 over the hips. That was super fun and that was at one end of the spectrum of the 100 per cent keyframe work of the animator."

Of the pipeline involved in creating the digital beasts named blurrgrs, Hickel recalls that, "It was a pretty conventional pipeline. We did walk and run cycles upfront and used those animation curves to drive a motion base, so sort of the top part of the saddle was built and Misty Rosas [in the Kuil costume] would sit up on that thing and do anything from a walk to fast trot. It just rocked and moved in conjunction with the animation curve so that when we plugged in the animation later of the rest of the creature, it lined right up. And, I have to say, this was my first show where we had that pipeline work all the way through. This was the first time that it was done properly and it worked gangbusters, and I'm going to fight harder [for it on other projects]."



Synonymous with *Star Wars* are its visually dynamic and intriguing spaceship designs that are often imbued with the feel of what George Lucas always described as 'a used universe', the beauty of which often resides in the fact that they are not always sleekly built vessels.

Hickel led the animation work involved in bringing the ship to the screen, and he identifies an 'old-school' approach that worked well within the digital

Top: Final shot showing Razor Crest composited with StageCraft-realised location

Above: The Mandalorian and IG-11 get caught up in a skirmish that's steeped in the style of a Western shootout

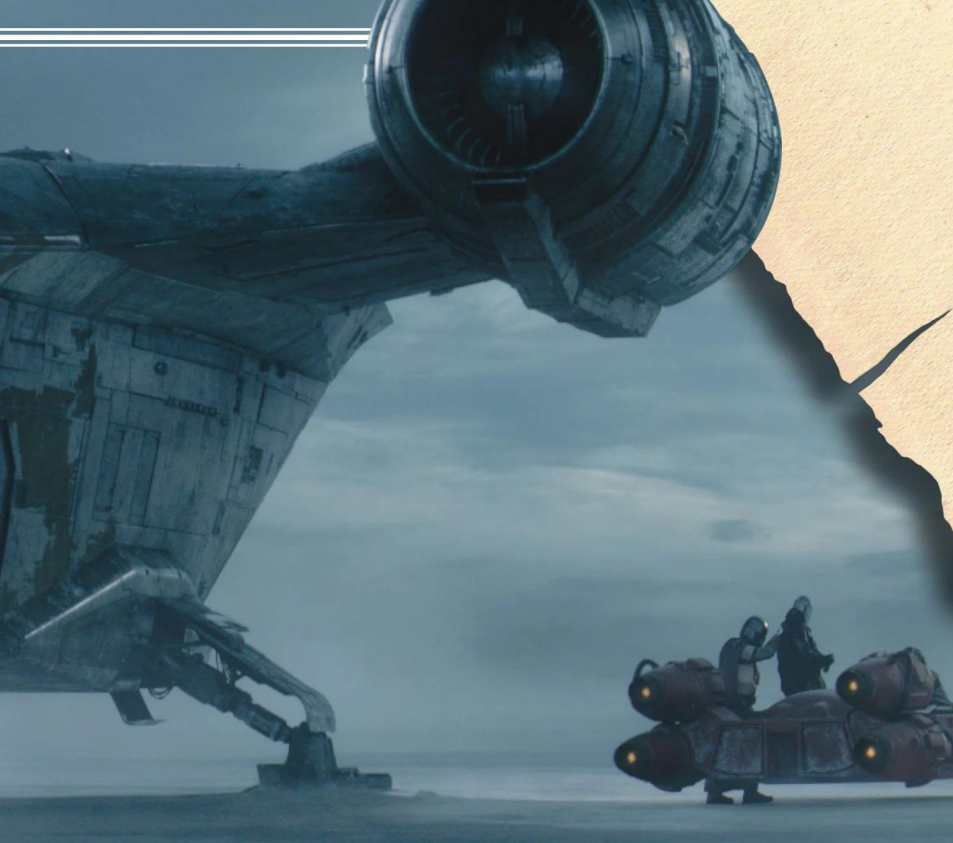
Opposite: Models of the Razor Crest landing gear for animation

production mode: "I animated myself a landing shot: it's the first time we land on Arvala. That was our first animated Razor Crest shot and I just wanted to define how this ship should land. Beyond that, we got into this discussion where Jon said, 'Let's build this model as lighting reference', because it's not finished like any *Star Wars* ships we've seen to date: it's not a mirror finish like Padme's ship [from *The Phantom Menace*] and it's not a matte finish like the Millennium Falcon or X-Wing, it's somewhere in between.

"So we started talking about that and then Jon pushed it a little further: 'Well, could we do some motion control work and shoot it as a miniature? So that shifted it into a whole other gear and we had John Goodson, who is a long-time model builder at ILM, both on the physical modelling side and the CG as well – he built

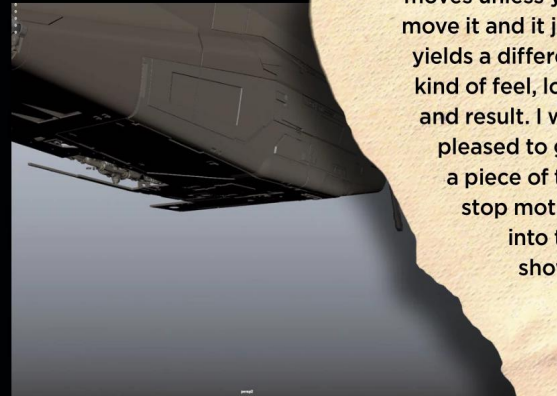
"WE'VE MANAGED TO INCREASE THE
SCALE AND SCOPE FAR BEYOND
ANYTHING WE THOUGHT WAS POSSIBLE"

Richard Bluff, visual effects supervisor, ILM



CG AESTHETICS

“One thing that Jon Favreau didn’t want with the CG animation,” Hal Hickel explains, “were certain things that he associates with CG animation and, in his case, negatively. I don’t always agree with him, but he very much wanted the rule to be: ‘If creatures are moving, there’s a reason they’re moving and don’t let things just drift around’, and that is something that can happen with CG animation because the computer is in-betweening, if you will. If you don’t go and adjust things and make sure that there’s a reason for the movement – that it doesn’t just drift between two keys – then you’re going to get that result. It did end up being a really useful style guide; because, of course, in stop-motion nothing moves unless you move it and it just yields a different kind of feel, look and result. I was pleased to get a piece of the stop motion into the show.”



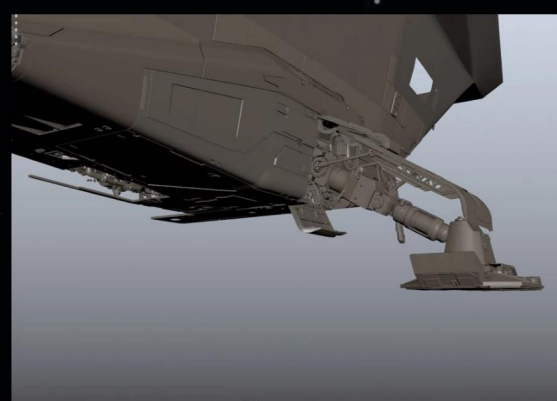
the Razor Crest in his shop – and John Knoll hand-built his own motion-control rig just for this. He sourced as much as he could from available parts, he hand-machined the parts he couldn’t buy, he built a camera mover and a model mover and then wrote his own software to run it. That’s classic John.

“So, we set it up on our motion-capture stage at ILM; we had about 40 feet of track and it worked great. To design those shots, I had a CG version of the motion-control rig way in advance of this, and I would animate the shots in Maya but using that motion control rig. In other words, I couldn’t design anything that the motion control rig couldn’t do. Sort of like doing tech viz, and part of that design process in the shots was not just adhering to what the rig could do for technical reasons, but it was also trying to enforce a style

guide that matched shots from the Original Trilogy.”

Hickel offers a reflective big-picture statement that captures the spirit of the work done and the work yet to be undertaken at ILM for the next series of the show. “I think there are times when filmmakers want to use an old technique for nostalgia but this really informed what we were doing in terms of the movement of the ship. It was really worth doing. It was great.”

Bluff brings the conversation to a conclusion, hinting at the scope of things to come: “With the experience of season one, we gained a huge level of confidence and with that we’ve managed to increase the scale and scope far beyond anything we thought was possible. I hear from a lot of people that season one didn’t feel like a TV show at all. Well, season two will make season one look like a TV show in comparison.”



Images courtesy of Industrial Light & Magic. © & ™ Lucasfilm Ltd. All rights reserved

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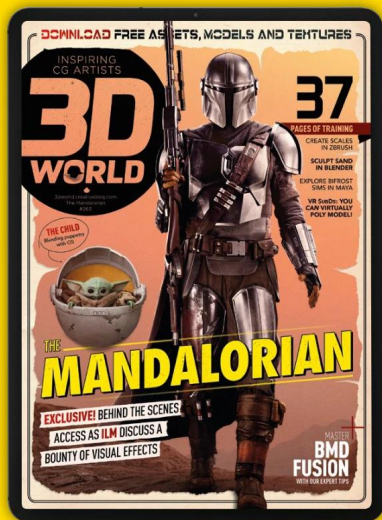
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The image displays three overlapping magazine covers for 'Paint & Draw'. The central cover is 'Paint & Draw PORTRAITS', featuring a woman's face being painted with a brush. It includes a 'NEW!' banner at the top stating '132 pages of expert advice and in-depth tutorials'. Other features on this cover include '15 tips on illustrating realistic heads', 'Artist secrets: Essential lessons from the pros', and 'Work with pastels'. The left cover is 'Paint & Draw OILS', showing a hand painting a woman's face, with a 'LIMITED COLOUR PALETTE' feature and '24 in-depth expert workshops'. The right cover is 'Paint & Draw ACRYLICS', showing pink flamingos, with a 'Learn from Kandinsky' feature and 'Airbrushes to palette knives'. A red circular badge in the bottom right corner of the magazine stack says 'WORTH OVER £20'. Each cover also has a 'Digital Edition' icon at the bottom left.

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THE IDEA FACTORIES

3D World speaks to those using CG software and technology to analyse, engineer and manufacture the tools of the future



BAC co-founder
and design director
Ian Briggs pictured
alongside the BAC
Mono supercar



Far from the action-packed world of media and entertainment, 3D software has found a plethora of uses in the realm of engineering and manufacturing. The same tools being used to make otherworldly vistas and super-powered characters in film, TV and video games are also aiding the design and manufacture of vehicles and appliances, as well as providing everyday tasks such as building management. In an ongoing effort to showcase all corners of the CG community, **3D World** spoke to some of the individuals behind these engineering innovations. They discuss their various uses of 3D software and technology, how it improves on more traditional methods, and how their respective industries could be changed by it.

SUPERCHARGING AUTOMOTIVE DESIGN

British supercar manufacturer, Briggs Automotive Company (BAC), recently teamed up with Autodesk to apply generative design methods to its design and manufacturing process. The move was made in a bid to further boost the performance of the BAC Mono, a light, high-performance, single-seater supercar. In March 2020, BAC unveiled the new-generation Mono, a product of its forays into generative design.

BAC's co-founder and director of product development, Ian Briggs, spoke to **3D World** about the thinking behind generative design and how it applies to the industry. "Powered by Autodesk Fusion 360, generative design has established strong use cases for innovating the automotive industry," he explains. "It uses a combination of artificial intelligence and cloud-computing to create design possibilities that take into account performance criteria and manufacturability requirements, allowing designers to explore thousands of designs in less time than they could deliver a single concept using traditional processes."

He continues: "The tool accelerates the design and manufacturing process, giving vehicle manufacturers a proven >

► way to improve fuel economy by replacing components with a variety of lightweight, recyclable materials. It also enables manufacturers to consolidate components into less parts.”

Together, BAC and the Autodesk Research team concentrated on applying generative design to the Mono’s wheel. “Preserving the aesthetic signature of the BAC supercars throughout the design process was essential,” adds Briggs. “The tool learned how to provide outcomes that still bore a close resemblance to our style.”

“Autodesk Research worked closely with our design team to understand these aesthetic requirements, and build this understanding into the generative design setup,” he continues, “resulting in a new wheel design which is a natural evolution of the original rather than a radical break in tradition.”

Once BAC’s manufacturing constraints and functional requirements were added to Fusion 360, the team was able to explore ways to make the Mono’s wheels lighter using less materials, while maintaining a strong aesthetic similarity to the way that the car itself is designed. “The results produced a remarkable wheel that’s 35 per cent lighter than before,” adds Briggs, “saving 1.22kg of reciprocating, unsprung mass –

weighing just 2.2kg per centre and taking the overall wheel weight to 4.7kg for each front wheel and 4.9kg for the rear wheel.”

These improvements combine to reduce braking distances and weight transfer for the Mono, helping to deliver sharper turn-in, provide better rotation at the apex and better traction out of corners. This is furthered by specially homologated Pirelli Trofeo R tyres being fitted as standard on all new Mono models.

The generative design algorithm in Fusion 360 improves on more traditional methods by producing thousands of solutions every minute. “In about four hours, it could produce the most optimised solution possible. This saved an unbelievable amount of time in the process and was the fastest that BAC has ever designed a wheel,” says Briggs.

Lightweighting in the automotive industry involves manufacturing vehicles that are less heavy and will therefore have better fuel efficiency and handling. It can be achieved by switching to a lighter material, or reducing the amount of material used in the design. Briggs continues: “Generative design allows us to improve the car’s performance and fuel consumption by redesigning components to use less material, replacing components with lighter materials, or to consolidate components into less parts.”

TOOLING UP

Autodesk’s computer-aided manufacturing (CAM) software is currently revamping the way tools are manufactured. RM Design and Engineering (RMDE), a UK-based tooling manufacturer, has expanded from being the solo

BAC Mono images: courtesy of BAC, photos by PaulHPhoto

Briggs is responsible for the creative design direction of the BAC Mono, from concept through to production implementation

For Briggs, BAC is the realisation of a lifelong ambition to develop innovative vehicles that show what is possible when we challenge convention





“GENERATIVE DESIGN ALLOWS US TO
IMPROVE THE CAR’S PERFORMANCE
AND FUEL CONSUMPTION”

Ian Briggs, co-founder, BAC



Above: The Rye Milling Machine that formed part of RMDE’s business expansion

To provide formal reports, RMDE recently added an inspection arm with Autodesk’s PowerInspect software

operation of managing director Radj Many to a team of six working with a range of equipment. RMDE specialises in tooling for vacuum forming, working with many of the UK’s leading automotive manufacturers on projects to supply prototype components, and low-volume production and packaging solutions. The company also designs and manufactures jigs for the production lines within the automotive supply chain, more recently moving into making tooling for the GRP and composites sectors.

Many started out with just one computer numerical control router, which he used for simple



jobs while operating as an agent for his customers. His relationships with staff from Jaguar Land Rover helped him drum up initial business and solidify RMDE’s reputation for high-quality and on-time delivery. As the business continued to grow Many added more machines, including a Rye five-axis router, a Dugard Eagle 1000 milling machine, and expansion into neighbouring units. The expansion also included the

addition of CAM programming with Autodesk PowerMill, a 3D solution for the programming of tool paths for CNC milling machines. “Everyone I spoke to said that PowerMill was the leading CAM software for toolmaking,” Many recalls. “Two comments kept being repeated – that you could do anything you wanted to with PowerMill and that the support from the staff in Birmingham was outstanding. In contrast, I had

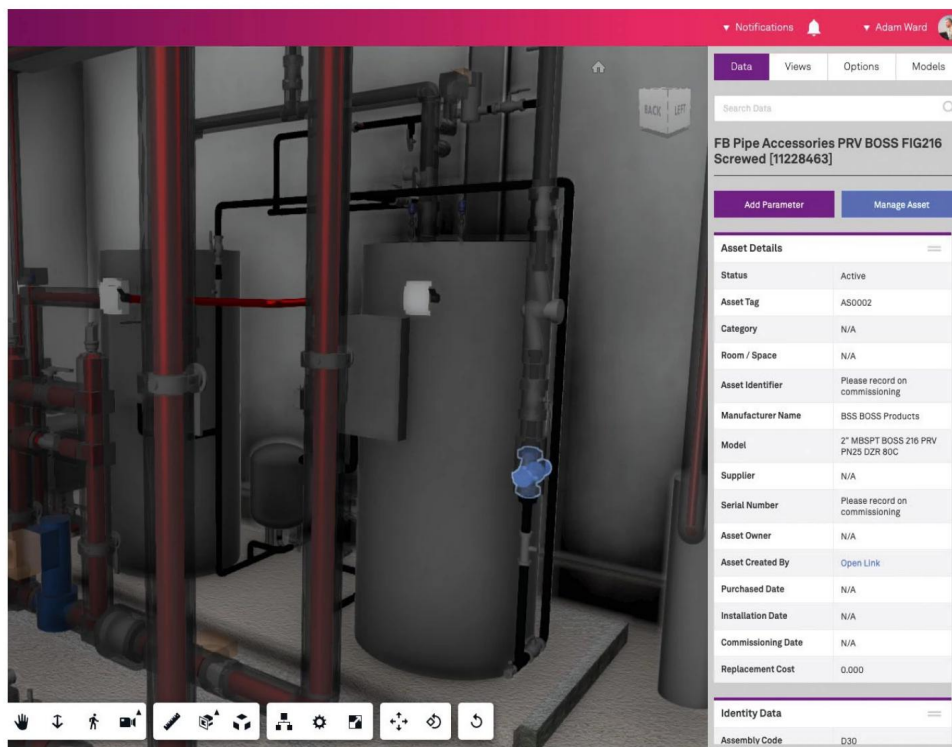
➤ experienced regular problems with the other software I had tried, so choosing PowerMill for my own company was a no-brainer.”

“Even though I am sure that we don’t use the full capabilities of the software, we can complete most projects quickly and efficiently,” he continues. “Whenever we meet any challenges, we contact the support team at Autodesk and they always come back with a solution, usually within an hour.”

The latest addition to RMDE’s toolset is a CMS Antares high-speed five-axis machining centre, which has a significantly larger bed than earlier machines. As well as allowing the company to take on bigger projects, the new machine gives a greater ability to boost productivity by making multiple parts in one operation. PowerMill supports this by allowing the toolpaths for the various components to be combined into a single project.

Many of the tools made by RMDE include undercuts that would previously have required multiple setups. The increased capabilities of the CMS machine form an important part of Many’s strategy to broaden the services offered by his company and gain more work in the manufacture of tooling for the composites industry. One of the first projects for the CMS was a composite tool for a customer from a Formula One team.

“This was a real challenge as I was learning the five-axis



Twinview worked closely with real estate investment trusts and digital specialists in the sector to ensure the platform helps to address a number of issues

Below: An example of Twinview’s detailed digital 3D replicas, which allow building owners and operators to manage their space

“BUILDING OWNERS WILL HAVE ACCESS TO UP-TO-DATE, REAL-TIME PERFORMANCE DATA”

Rob Charlton, CEO, Twinview

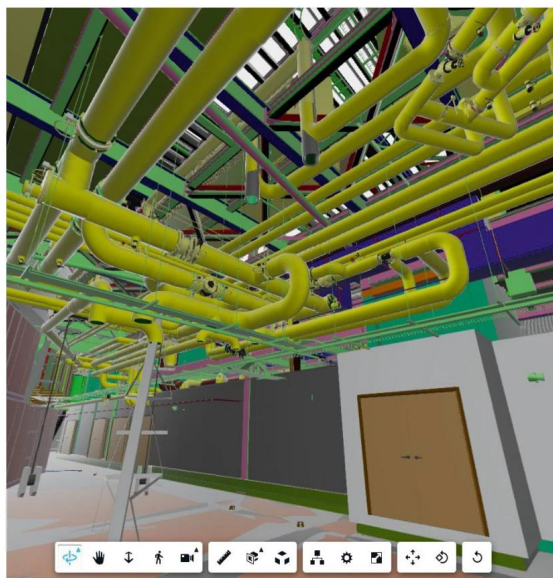
options in PowerMill while I was programming the job,” said production manager, Marius Pantea. “The simulation and verification tools were essential in locating any problems and in helping me to come up with programs to avoid them.” The simulation tools also help to plan and complete operations by providing an exact image of a roughed part, showing where material still needs to be removed, also aiding the selection of the most suitable tooling and strategies for the finishing cuts.

“My customers know that we are not the cheapest supplier, but they are willing to pay extra for the quality we provide and our ability to meet deadlines,” adds Many. “I want to work with the best suppliers, like Autodesk, that put the same emphasis on service for their users that I put on supporting my clients.”

BRIDGING A GAP

Elsewhere, 3D technology is finding everyday uses in areas like building management. Twinview, a brand-new, digital twin platform has been launched to change the way buildings are managed, helping to make them safer and more energy efficient. The platform is powered by cloud-based, 3D digital twins, digital replicas of physical buildings, which connect the virtual and the physical buildings with real-time analytical data. This allows building owners to manage, monitor and maintain critical construction and operational information. This will enable them to ensure buildings are functioning safely and efficiently.

CEO Rob Charlton saw a gap to be bridged when he first dreamt up Twinview. “We were developing detailed models for REITs in London and at the end of construction they could not access





ACRONYMS EXPLAINED

DON'T KNOW YOUR CAD FROM YOUR CAE? DON'T WORRY, 3D WORLD IS HERE TO HELP

BIM

Building information modelling covers various tools and software that create and manage digital representations of real buildings. The data provided can be used to manage the physical and functional aspects of the building in question.

CAD

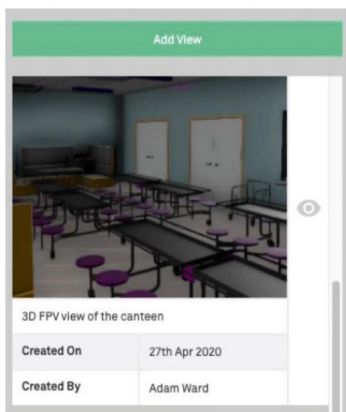
Computer-aided design utilises digital technology to create, analyse, modify or optimise a design. CAD techniques are key to many industries including automotive, aerospace and architecture.

CAE

Computer-aided engineering denotes the use of digital software or technology in engineering analysis. Often CAE involves the analysis of a 3D visualisation of a design, testing and simulating it before it is manufactured physically.

CAM

Computer-aided manufacturing uses digital software to control machines and automate the manufacturing process. CAM software creates toolpaths for manufacturing machines to follow and converts them into a language the machines can understand.



the detailed model information as there was a need for expensive software and hardware to do so," he tells **3D World**. "At the same time it was clear that not many building owners had facilities or asset management systems in place, because available platforms had been developed for other sectors such as oil and gas and therefore were expensive."

Twinview bridges this gap, giving building owners access to all of their information on the cloud without any need for expensive hardware or implementation. As a SaaS platform which can be deployed with little training or expensive software, it requires no significant capital investment. "The project began by understanding the need," Charlton continues. "We then progressed with the development of the technologies to allow large models to be hosted on the cloud and more importantly to

be queried quickly. Once we knew we could access the data and model instantaneously in a split second we began to develop the Facilities Management workflow."

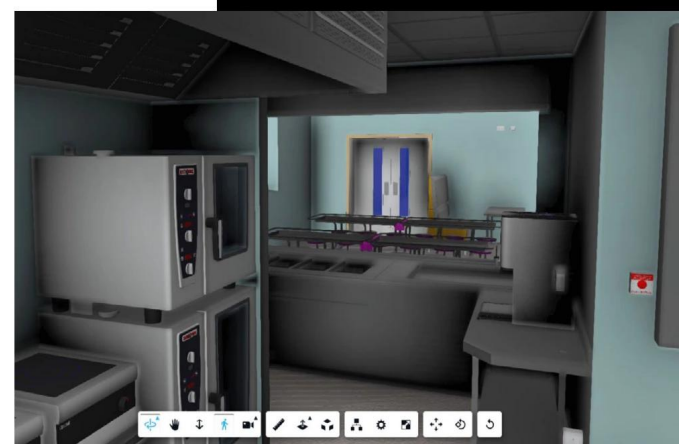
He continues: "When the operational interface was complete we began to look at the integration of IoT devices using APIs. We trialled this technology at our head office by installing sensors on all major pieces of the plant. At this point we had a Minimum Viable Product and were read to move into Beta and then to market. From June to December 2019 Twinview was in beta and by early 2020 we were ready for launch. We are currently developing the fourth module, Capture, which is a data management and surveying application and is currently in Beta and will go live in June 2020."

Twinview is set to change the way buildings are managed by reducing property costs and making buildings safer. "By having access to up-to-date, real-time performance data, building owners and operators can optimise building performance by adjusting heating, cooling and maintenance to ensure it is as efficient as it can be, therefore reducing cost, waste and carbon," Charlton explains. "Following the Grenfell disaster it is clear that building owners do not have access to up-to-date information about their building. With Twinview, landlords will have this information at hand."

Twinview is already in discussions with a number of national and international businesses about the platform

In the long run, it is envisaged that Twinview will be used by contractors and designers across sectors such as hospitality, retail, infrastructure, transport, private housing and schools

For more information on Twinview, and to book a demo of the platform, head to twinview.com



34

PRO TIPS FOR

FUSION

Whether you use the free version of Resolve's Fusion or standalone Fusion Studio, these expert tips reveal what this compositing platform can do for you

Compositing is essential to any professional VFX pipeline: used extensively even on features and television shows where effects are invisible to the naked eye.

Formerly developed by eyeon Software, Blackmagic Design's Fusion is a node-based VFX and compositing tool that the industry has relied upon for decades. There was even a version of the software produced in partnership with Alias

Wavefront in the late 90s. The latest iteration from Blackmagic Design is available as a free download as part of their NLE and colour correction software DaVinci Resolve, or as a standalone package – and it's much more than just a professional compositor. From creating god rays to working with ACES and even generating rain particle FX, over the next few pages you'll discover the best tools and techniques that have made their way into top Fusion experts' workflows.

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01 INSTALL THE REACTOR PLUGIN

Reactor is a free, open-source package manager that I would recommend for both Fusion and DaVinci Resolve users. It streamlines the installation, distribution and management of third-party content like scripts, fuses, macros, templates and titles. With Reactor, you can install these with a click of a button, rather than having to download, copy and edit individual files manually.

Download it at We Suck Less (www.steakunderwater.com/wesuckless/index.php). **Tom Hankins, Colorbleed Animation Studios**

02 USE TONEMAPPER FOR A FILM LOOK

One of the more interesting tools available in Fusion is called the 'Tonemapper'. It's something that we've used on virtually all our projects since its introduction.

By tone mapping using 'filmic' curve interpolations, you can create a far more realistic final look for your film. What basically happens under the hood is a Reinhard filter is combined with an S-Curve, giving an image contrast without blowing it out. The process

gets rid of any unwanted oversaturated highlights, making final frames more pleasing to the human eye. I especially enjoy the way it handles skin tones, as seen below. **Tom Hankins, Colorbleed Animation Studios**

03 CREATE BETTER SLOW MOTION

A great workflow to slow down footage from either a camera or CGI render is the 'optical flow' node, in combination with a 'time speed' node.

When slowing down footage, you usually either get stuttering or a horrific blending of frames. With optical flow, intermediate frames are created. When plugged into a time speed node, these additionally generated frames give slow motion much smoother results.

What some people might not know, is that by using a 'Copy Aux' node you can convert the generated vectors from the 'optical flow' node to colour values for all sorts of crazy results.

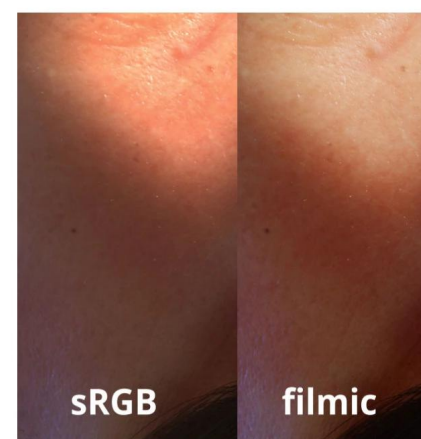
Tom Hankins, Colorbleed Animation Studios

04 TAKE ADVANTAGE OF ACES

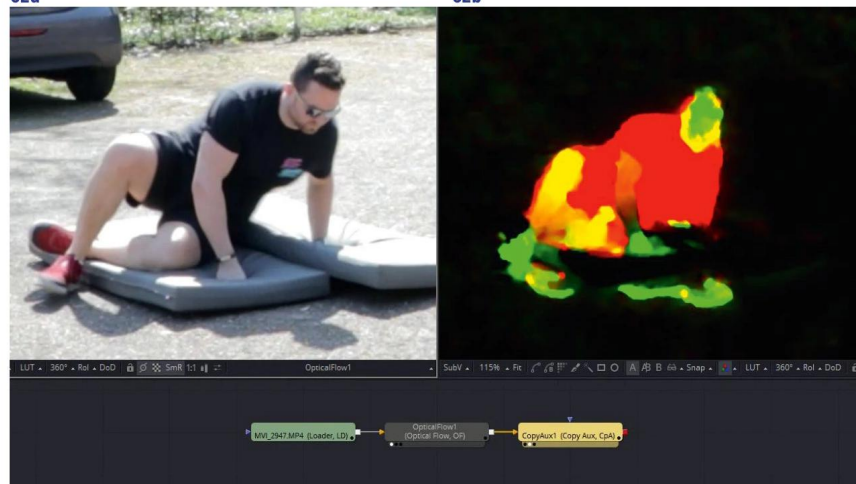
One of the great features of Fusion inside DaVinci Resolve is its integrated support for ACES colour



02a



02b



03

Colorbleed concept art from cinematic game trailer 'Legend of Ikto' created with Fusion



05

► management: a VFX industry standard. ACES is incredibly powerful. Having all your assets converted and rendered into a standardised ACES workflow ensures that the colours remain consistent across all software packages in your pipeline. **Allar Kaasik, Escape Studios**

05 USE RESOLVE AS A REVIEW TOOL

If you use Fusion in DaVinci Resolve, switch to the editing timeline for a quick way to view all the shots in a sequence together and check for inconsistencies. **Kenneth Turner, Lexhag VFX**

06 REMEMBER, FUSION COMPS ARE PLAIN TEXT FILES

It's pretty easy to generate Fusion comps directly from other software like 3ds Max or Maya. If you haven't done this, just drag a Fusion comp file into a text editor: you'll see that all Fusion comps are plain text files.

You can also speed up your workflow with almost no knowledge of what the Fusion code means. When pulling shots from the archive, for example, you might notice some Fusion loaders have broken paths. This is inevitable with old shots, where source files have been moved for long-term

storage. While we can go through all the loaders and relink them by hand in Fusion, it's much easier to do this in a text editor.

The script for a Fusion loader looks like this:

```
Loader1 = Loader {
  Clips = {
    Clip {
      ID = "Clip1",
      Filename = "D:\\miaos_ep1\\
miaos_280_bg_v01\\miaos_280_bg_v01.1001.dpx",
      FormatID = "DPXFormat",
      StartFrame = 1001,
      Length = 114,
      LengthSetManually = true,
      TrimIn = 0,
      TrimOut = 113,
      ExtendFirst = 0
      ExtendLast = 0,
      Loop = 1,
      AspectMode = 0,
      Depth = 4,
      TimeCode = 1245063,
      GlobalStart = 0,
      GlobalEnd = 113,
    },
  },
}
```

If you want to fix the broken file paths and point them to a new location, you can simply search and replace the

filename text. So for me, I can change D:\\miaos_ep1\\ to z:\\lexhag\\miaos_ep1\\, save the .comp file and when I reopen it in Fusion, all the loaders are good to go. **Kenneth Turner, Lexhag VFX**

07 CUT AND PASTE TOOLS FOR EASY SHARING

This is definitely a top tip for our times. When you copy and paste tools in Fusion, the script is transferred as plain text to the operating system clipboard. This means you can copy tools in Fusion and paste the text into any document. If you paste the text into a chat window or a forum post, then anyone can copy and paste it back into Fusion to recreate the tools. This is great for remote working and shot reviews. In video calls, we can share screens and copy tools directly from Fusion to the chat window as text.

Kenneth Turner, Lexhag VFX

08 USE THE MERGE TOOL'S ADDITIVE BLEND MODE

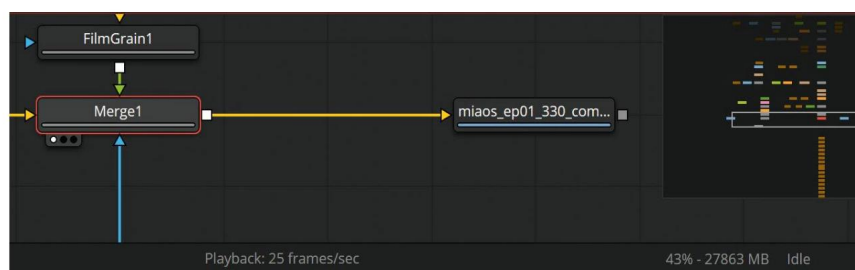
Additive blending is great for all kinds of FX tricks. The Fusion merge tool doesn't have Additive as an apply mode option, but it does do additive blending. To get this working simply set 'Apply Mode' to 'Normal' and 'Alpha Gain' to zero. By setting the alpha gain to zero,



we change a normal blend mode into an additive blend. If you want to know more, then check my personal website: www.designimage.co.uk/merge-tool-maths. **Kenneth Turner, Lexhag VFX**

09 SIMPLIFY YOUR FLOW FOR SPEED AND LEGIBILITY

Fusion comps are computer programs. The less calculation the program has to do, the faster Fusion will update frames. While we're being creative, our tool flow can become a bit of a sprawl. But it's always worth going back and cleaning up. A lot of my matte paintings are split across two composites. The first is to design the look and get approvals for a single frame. Once the frame is approved, I render it as an EXR and track into place in a second comp. This means I can be messy and creative in the first comp, then clean and



10



12

optimised in the second where I need faster render times. **Kenneth Turner, Lexhag VFX**

10 CACHE FOR SPEED IN FUSION 16: REMEMBER RAM

Fusion automatically caches frames to RAM for instant playback. For simple shots, this means that working in Fusion is pretty fast so long as you don't run out of RAM. The current amount of RAM used is reported in the lower right of the status bar. You can increase the RAM used by Fusion by going to Preferences>Global and default settings>Memory and increasing the Caching limit. **Kenneth Turner, Lexhag VFX**

11 LEARN ABOUT DOMAIN OF DEFINITION (DOD)

To speed up workflows on heavy composites, it's best to understand Domain of Definition (DoD). The DoD is a rectangle representing the area of the frame that contains data. You can see the current DoD by selecting a tool then right-clicking on the view and choosing Region>Show DoD. In Fusion 16 you need to click and hold the Rol - or Region of Interest - button. The DoD changes size from tool to tool, sometimes smaller than the final frame and sometimes larger. This is

actually pretty neat because Fusion only calculates what it needs to in each frame. While the frame can be large, if the DoD is small, the image updates quickly. By changing the order of nodes in the flow we can decrease the DoD size and also decrease render times.

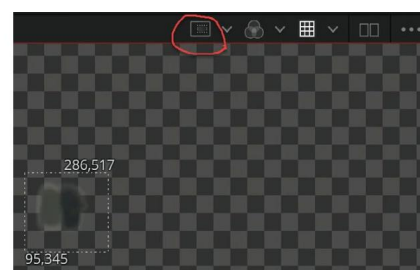
Kenneth Turner, Lexhag VFX

12 MULTIPLE UV TILE 3D MODEL TEXTURING SETUP

We often use Fusion for texturing 3D models, particularly when we're integrating animated textures, or using projections. This is so we can composite directly on the UV maps and see the result in real time, then write back to the texture map for the final CG render out of the 3D application.

In the case of our Cosmic Tortoise character, we wanted moving nebulous textures on his skin, as well as twinkling stars on his shell. The Cosmic Tortoise 3D model consists of three main pieces of geometry, each with multiple UV tiles due to the resolution we needed for the final renders out of 3D.

Fusion has a Texture Transform tool that allows you to offset texture maps in UV space. Simply change the correlating attribute, in our case 'U' to match how it was specified in 3D. Per UV tile, the flow is the Loader with the map (and whatever subsequent



11

13 POSITION PASS MAGIC

USE FUSION'S 'VOLUME MASK' TOOL TO ISOLATE PARTS OF A RENDER WITH A MASK THAT MOVES PERFECTLY WITH THE CAMERA

i. Make sure your renderer is set to save a 'World Position Pass' AOV, often called just 'Position.' Once you have your rendered Position AOV, load it into Fusion and assign the R, G and B channels to the X, Y and Z Position channels in the loader's Format tab.

ii. Now pipe that into the Volume Mask node and you're ready to select the area of your image that you'd like to create a mask on. Set the Volume Mask node to a viewer. Now in the Volume Mask tool, drag the eyedropper tool to the viewer to select a location on the image. Under the hood, Fusion will select the appropriate values from your Position channel. This area you have selected will be the centre of your mask.

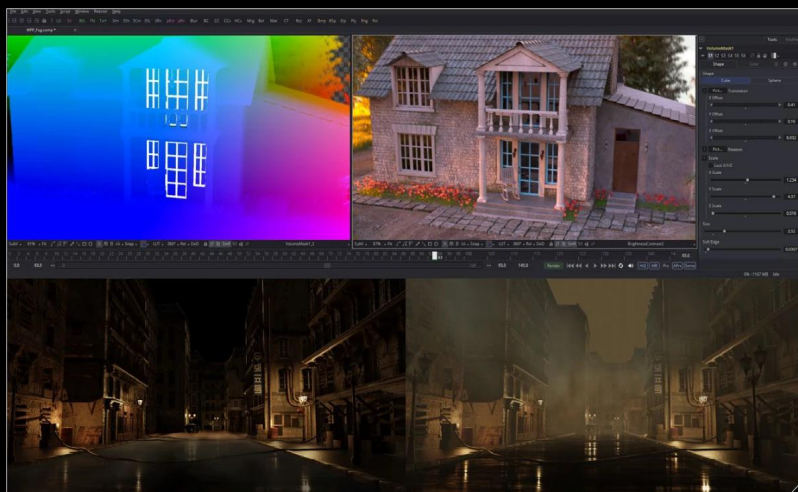
iii. You should now see the default mask that has been created. All that is left to do is adjust the size, softness and position of the mask. Make sure to check 'Mask Only' under the Color tab of the Volume Mask tool when you've got everything dialed in. In my example, I moved the position and scale of the mask to isolate the wooden borders of the front door windows so I could change the colour.

iv. You can apply this same workflow to create Volumetric Fog to add a sense of depth. Pipe the same 'Position' AOV that you've loaded in the previous steps into the 'Volume Fog' tool. Selection of the fog area is the same as what we did for selecting the mask area previously. For the fog, I'm going to soften the mask area by dragging the 'Soft Edge' slider.

v. I am also importing an FBX with the camera and scene lights from this render, because the Volume Fog tool can take a 3D scene input and simulate light scatter and absorption. This allows for many different looks to be created, all correctly masked and remaining in the correct position as the camera moves, because again, this is all calculated volumetrically. This tool also allows inclusion of 3D volumetric noise, via the Noise tab.

vi. This means you can create much more detail and have wind 'blow' the 3D noise detail in different directions by keyframing the translation of the volume, adding to the feeling of depth, as well as setting the 'Seethe' rate, which will cause the 3D noise to evolve over time.

Matt Hoffman, BluFire Studios



14

> comping you want to do on it) > Material > Texture Transform > FBX Mesh 3D. Each is then connected to the merge 3D. **Adam Clark, Trick Digital**

14 USE THE 3D PARTICLE SYSTEM

Effects like blowing leaves, raindrops or snow can be quite easily set up in Fusion's 3D Environment. It's even possible to have particles in Fusion interact with geometry imported from your 3D department.

For example, for rain effects, you can use different rain drop textures to add some randomness to each rain drop. In this project setup, I used an image sequence made up of ten different rain drops and set the 'Style' to Bitmap and the 'Animate' to Particle Birth Time. With that base setup, I could generate simple 2D rain effects that could then be added to a 3D particle system to collide with geometry. **Julius Worm, FREIRAUM FX**

15 LEARN ABOUT TEXT MODIFIERS

Fusion's Text Tool has many options to explore, including modifiers for interesting title animation. The Follower modifier, for example, can be used to create a time offset for each character, delaying animated parameters like scale or opacity.

Julius Worm, FREIRAUM FX

16 USE WORLD POSITION TO RECREATE A 3D SCENE

In addition to the three nodes listed in the Fusion User Guide, there are occasional other Fusion tools that



20

can take advantage of a World Position Pass (WPP). One of these is Displace3D. Set the Channel to Pos and Mode to Absolute. Feed the node a Shape3D in Plane mode with subdivisions equal to your render resolution minus 1. The plane will assume the shape of the rendered geometry. **Bryan Ray, Muse VFX**

17 CONFIGURE YOUR CAMERA WITH EXR METADATA

When importing an FBX or Alembic, Fusion discards the original reference and instead creates a camera with baked keyframes. To avoid the loss of synchronization between camera and render versions, Muse instead uses the metadata encoded in Redshift renders to drive the camera. The metadata contains a transformation matrix, which must be translated into Euler angles for use by expressions on the camera. We've made our Redshift Camera Extractor fuse available on the Muse VFX website, along with a setting file for a camera that is configured to use the metadata (www.musevfx.com/tools). The Fuse is well-documented to make it easy for a TD to modify it to handle metadata from other renderers. **Bryan Ray, Muse VFX**

18 RELIGHTING IN THE 3D WORKSPACE

With both geometry and a camera, adding lights or other elements to the scene is easy. To improve the lighting, give the geometry a simple white material (the default) and add a light

to the scene. In a linear workflow, lights can be simply added to the render using ChannelBooleans in Add mode. Don't forget to set Alpha to Do Nothing! The limitation to this technique is that the WPP has no data about occluded geometry, so shadows might reveal the 'rubber sheet' nature of the model. **Bryan Ray, Muse VFX**

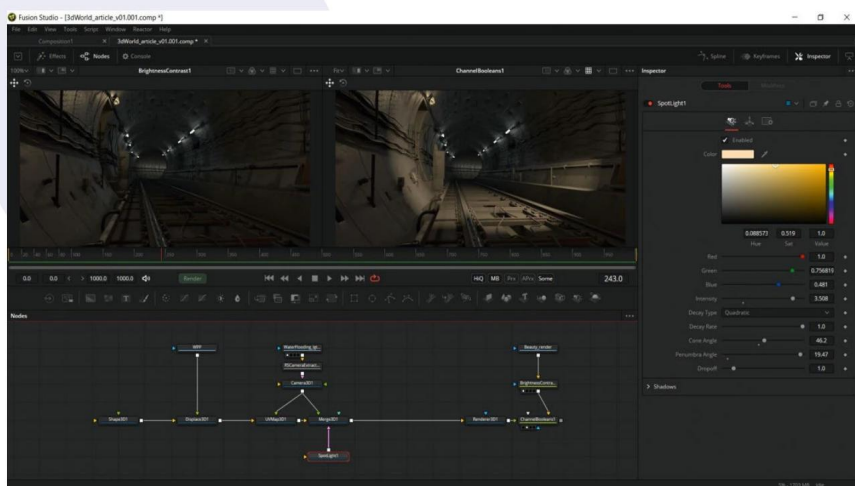
19 PICK WORLD POSITION COORDINATES FROM A RENDER

3D tools with Transform controls are aware of World Position channels in an image, allowing you to pick a location directly from the 2D Viewer. You can inject the WPP from the original render, or simply turn on World Position of the Renderer3D node. Auxiliary channels of an image in the Background input of a Merge are preserved, so you can place an object in 3D space by dragging

the pick button onto the 2D Viewer. You can also pick rotation values if the Normal channels are available. **Bryan Ray, Muse VFX**

20 SHARPEN, BLUR, GLOW, AND GOD RAYS

Because of anti-aliasing, 3D renders frequently need sharpening to allow the details to pop, and add that bit of extra realism. I use Fusion's sharpen effect on almost all my renders – you can find it under AddTool>Blur-Sharpener. I also use the glow effect, which you can find under AddTool>Blur-Glow to add a warmer look, or enhance a hazy feel from volumetric lights. Another useful effect is god rays, which you can find under AddTool>Effect-Rays. These can add some gorgeous lighting effects to your render. **Nabil Matiben, 3D generalist**



18

21 ADD CHROMATIC ABERRATION

Chromatic aberration can add some really nice vintage, photographic looks. Motion designers also sometimes animate chromatic aberration with shake modifiers to create cool glitches. In Fusion, you can add chromatic aberration with the tool found in Fusion Bins. Just press Ctrl+B under Templates>Fusion>Tools. **Nabil Matiben, 3D generalist**

22 REMOVE FLICKER WITHOUT A CLEAN PLATE

If you ever need to remove flickers that are part of a repeating pattern, you can do this in Fusion by offsetting the footage by one frame and merging it on top of itself at 50%. First, stabilise the shot (Tracker>Match Move>BG only). Next, branch off your Tracker to a Time Stretcher. On frame 0, the Time Stretcher should be frame 1.

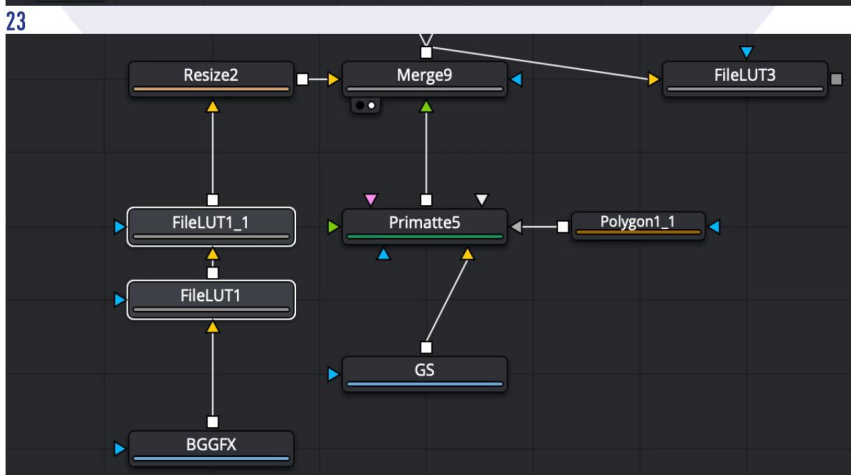
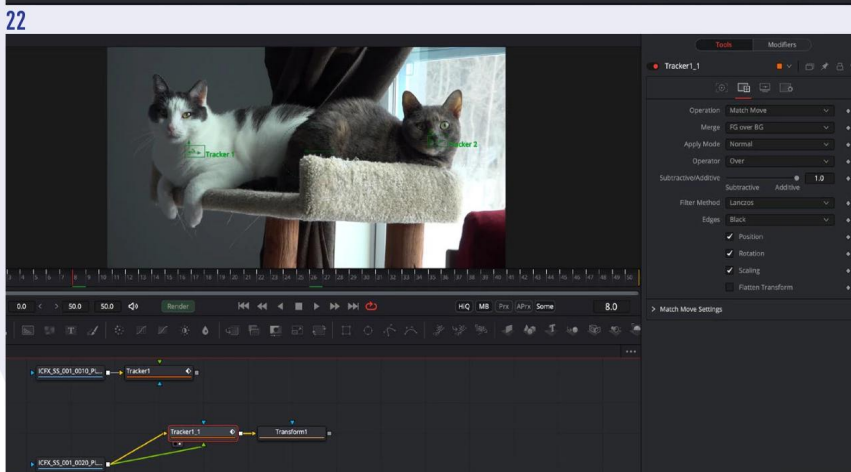
On the last frame, set the time stretcher to one frame longer than the global range. On the original loader, you'll then need to add a hold frame on the last frame to extend the shot by 1. Now Merge the stabilised footage (BG input) with the Time Stretcher (FG input) and set the Blend to 0.5. If it was a repeating pattern, the flicker will be cancelled out. **Shaina Holmes, Flying Turtle Post**

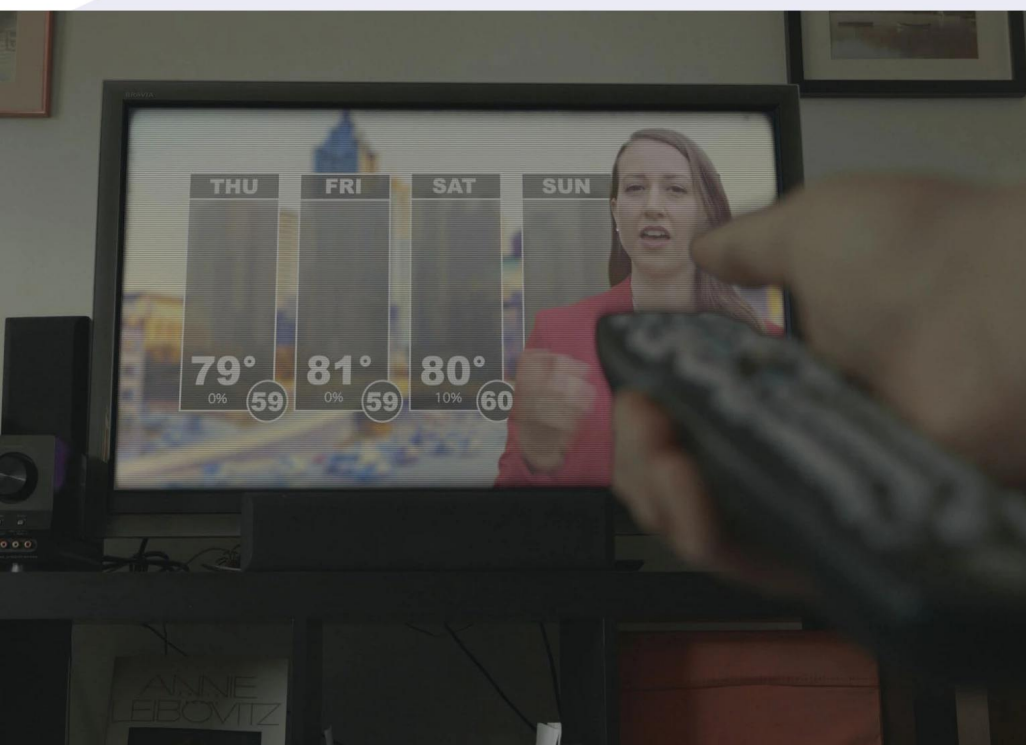
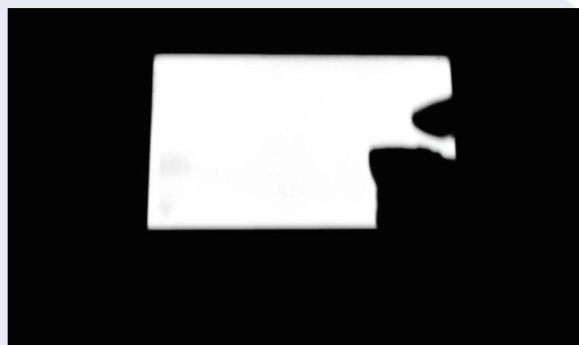
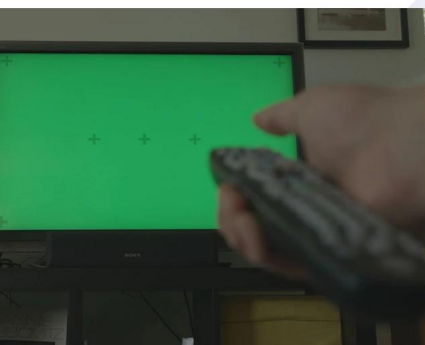
23 ADD NATURAL HANDHELD CAMERA MOVEMENT

Many VFX shots are locked off so compositing is easier, but then when these shots are cut back into a scene with handheld camera movement, they feel out of place. To add handheld movement back, some may be tempted to use the Camera Shake tool. I find it never quite looks natural enough, so my suggestion is to use Fusion to track a shot from the scene, even the reference QT, and apply that same tracking data to this shot. Just make sure the shots aren't right next to each other in the scene or it may look repetitive. **Shaina Holmes, Flying Turtle Post**

24 USE LUTS TO WORK IN MIXED COLOUR SPACES

Most footage these days is in a Log colour space, retaining more dynamic range – but this looks very flat and desaturated. If you need to do a screen replacement, usually the footage or graphic you are inserting is a linear colour space, which looks good on your monitor, but will not match the original log footage. Best practice would be to





use a transformation LUT, or look up table, to convert the linear (i.e. sRGB or REC709) image to Log (i.e. Log-C).

In most cases, the client should be providing the LUT for the shot for when you make editorial deliverables for them. I collect transformation LUTs from projects I've worked on so I'm ready for any colour space. Sometimes you need to convert sRGB to Linear first, then Linear to Log-C, so you may need to use more than one LUT in your comp. **Shaina Holmes, Flying Turtle Post**

25 PROVIDE ALPHA MATTES TO COLOUR/CONFORM

For any screen replacement or greenscreen shots, always provide a black and white matte along with your final render to the post house. This way, the colourist has complete control over balancing the insert footage into the rest of the scene depending on final colour. Otherwise, if they cannot track a precise power window or apply colour grade to the entire shot, it will get kicked back to VFX for a colour fix.

To do this in Fusion, branch off a second saver after where your masks or alpha channels are all merged together. On the export tab, save Alpha to Color. Make sure to export the same exact number of frames as the rendered final shot, even if the mask is only used for a few frames. Also, name the render the same exact name as the VFX shot with "_matte" appended at the end.

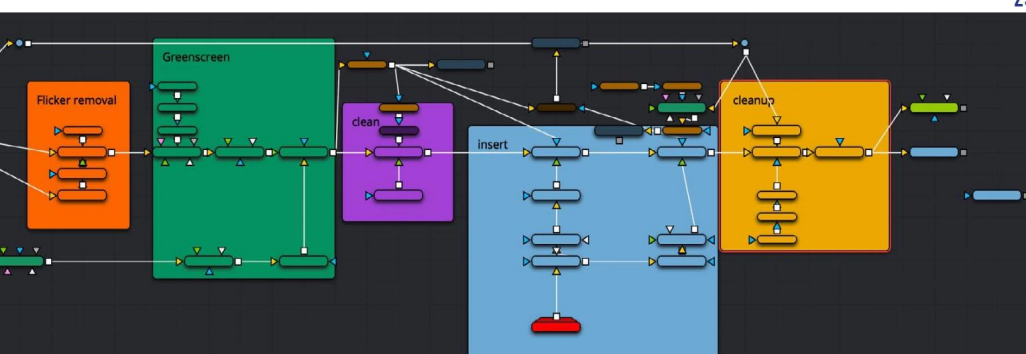
Shaina Holmes, Flying Turtle Post

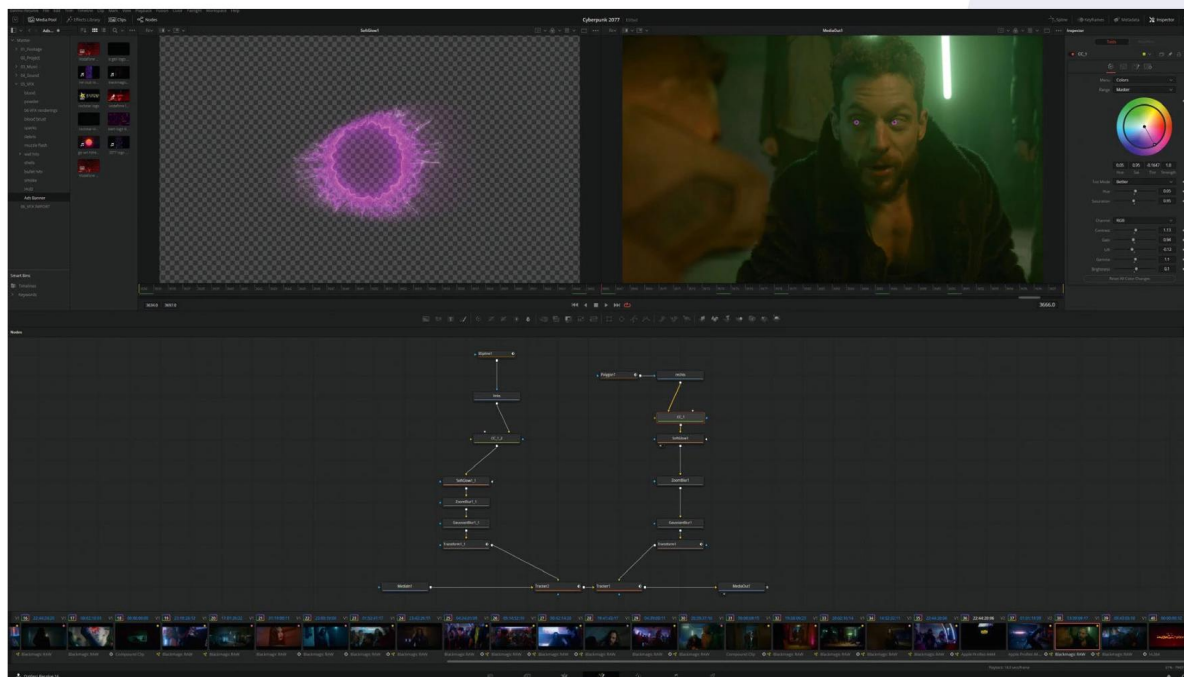
26 ORGANISE YOUR NODES

When working on a VFX team, it is always smart to work as organised as possible in case someone else needs to open your comp after you. First, in the Flow area, right-click>Arrange Tools>To Grid. This will create a much more regulated structure when adding nodes by snapping their placement to a grid. Another good practice is to use the Tools>Flow>Sticky Notes and Underlay to label sections of the node tree or leave notes for the next person who opens the comp. This can be used in conjunction with Groups. If you, for example, have ten paint nodes in a row, you can highlight them all, right-click>Group. Changing the colour of the notes and sections makes it even easier for someone else to decipher your comp. **Shaina Holmes, Flying Turtle Post**

27 NAVIGATE THE INTERFACE

Navigating the Flow area is intuitive, but a couple of tips can help >





31

you go faster. Scroll vertically and horizontally to move across the flow area, or hold down the middle key (mouse scroll wheel) to get a freehand tool for navigation. Hold down Cmd (or Ctrl) and scroll in the flow area to zoom in or out – very handy if you are working with large comps with a lot of nodes. These same commands also work when moving around the video preview windows. **Veikko Luukkonen, Phenomenal Creations**

28 THE MOST IMPORTANT SHORTCUTS

You can easily access the entire Fusion effects library simply by hitting Shift+Spacebar. This shortcut lets you see all the various tools available to you in an instant. Just scroll to find the

one you want – or you can use the text search area to quickly find what you are looking for. Hitting Enter (Return) will apply that tool as a node to your flow area.

If you already had a node selected before adding the new tool, hitting Enter will automatically connect it to your previous node. Now, by pressing 1 or 2 on your keyboard, the merge node result appears on one of the video previews. **Veikko Luukkonen, Phenomenal Creations**

29 USE THE PAINT NODE FOR GLOW EFFECTS

The paint node allows you to turn your cursor into a brush, and start painting on top of your footage. Set the background colour to transparent

(alpha slider turned down) to see the paint effect on your footage. By selecting the soft glow effect, you can then change parameters like glow size and colour. Change the brush size on the fly by holding down the Cmd/Ctrl key and then clicking-and-dragging left to right. After you have dialed the effect to your liking, you can paint in neon in real time! **Veikko Luukkonen, Phenomenal Creations**

30 GET BETTER PLAYBACK

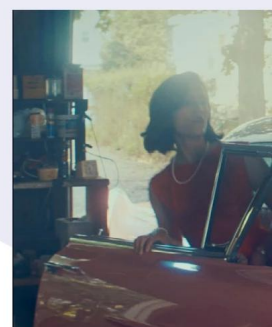
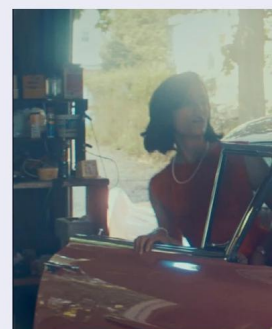
Many might not realise this, but there is a 'hidden' control at the play button area in Fusion – right-click on it, and disable high quality and motion blur. Then, right-click on the play button and set Playback update to 'fast'. This should instantly give you better playback. **Vi-Dan Tran, Jackie Chan Stunt Team**

31 ADD MOTION BLUR

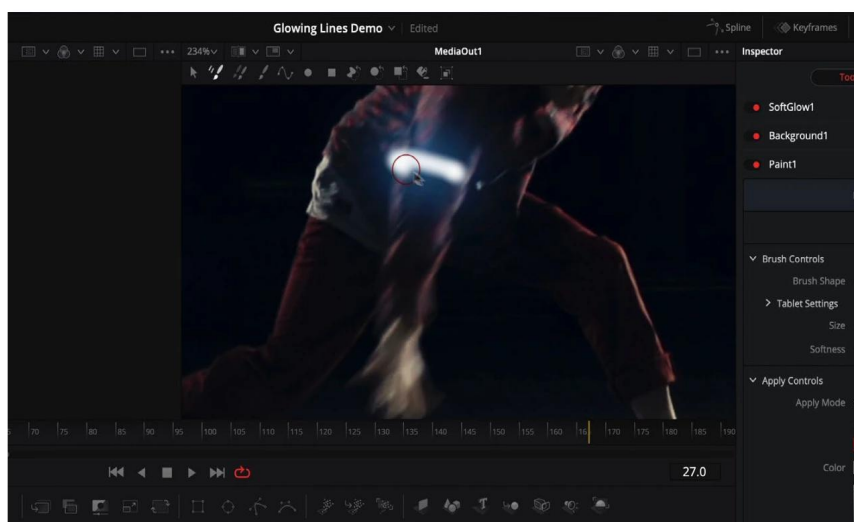
This can really enhance the filmic look of your work, especially if you're finishing action sequences or car chases. In Fusion, motion blur is hidden in every transform or merge node in the inspector. Experiment with it for some interesting final results. **Vi-Dan Tran, Jackie Chan Stunt Team**

32 INVISIBLE FIXES

The Clone brush, which can be found in the Paint tool, is great for invisible fixes. While grading this short film, I was asked to remove a reflection of the boom mic in the windscreen of



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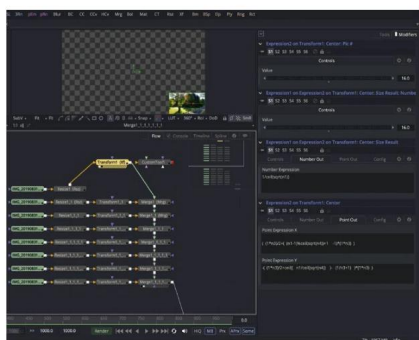
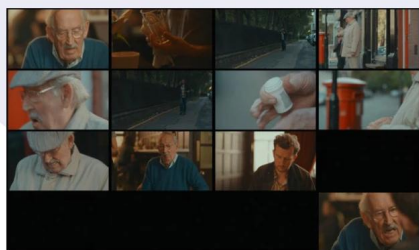


the car. I found a point on the rear-view mirror which I could track, and made a clean patch to place over the reflection.

Jamie Dickinson, freelance colourist

33 GRID LAYOUT MACRO

Several people have asked recently about making a grid layout in Resolve and Fusion. It's not something that is built in to Fusion, but Fusion is very easily customised so I was able to create a Macro to achieve this, using two standard tools and a couple of expressions below. I started this in Fusion 9 standalone, but it does also work in Resolve Fusion too. **Jamie Dickinson, freelance colourist**



33

34 MOONRAKER'S GRAHAM STOTT ON DISPLACE3D

USE DISPLACE3D FOR PROJECTED SURFACES AND PARTICLE SYSTEMS

Displace3D is very handy for creating complicated geometry catchers for projected surfaces, but it's also interesting to use with animated heightmaps for meshes in particle systems.

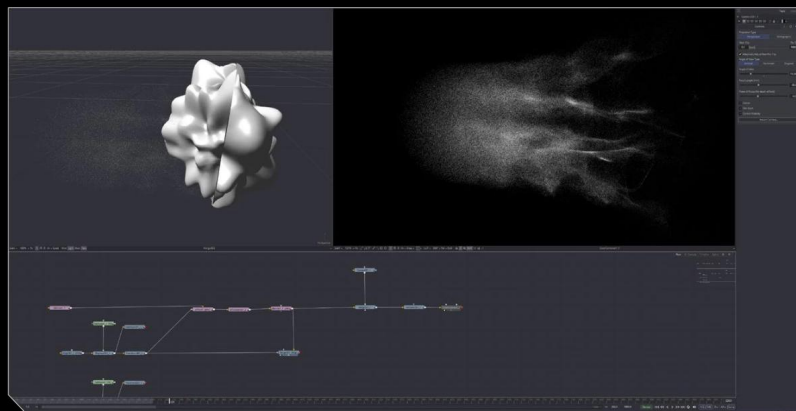
i. Create a particle system that emits from a sphere along a vector. Set the particle style to any of the circular ngons and reduce the size to the sub pixel level, check supersampling on and set the composition render quality to HiQ.

ii. Next, create a shape to disrupt the flow of the particles (for now use a simple plane) and up the polygon count to a higher number than the default – try 100 to begin with. After the shape node, plug in a Displace3D node and then plug a fast noise into the displacement input. Create a Merge3D and plug it all in. Add a transform node after the Displace3D and reposition the plane so that its displaced surface is intersecting the flow of the particles.

iii. Now let's use the pAvoid node to generate some interactions between the particles and the displaced plane. Under the region tab select 'Mesh', then connect the displaced shape.

iv. The trick now is to experiment with different distance and strength settings inside the pAvoid node against different displacement settings of the fastnoise. The scene should be relatively quick to preview and render time will be negligible, so try setting different seed rates in the noise, to animate the displacements that are interacting with the particles.

Of course you aren't restricted to connecting the displaced meshes to pAvoid, animated displaced meshes can be used as emitters as well as collision objects – so get experimenting! **Graham Stott, Moonraker VFX**



The Pipeline

Practical tips and tutorials from
pro artists to improve
your CG skills



AUTODESK MAYA | BIFROST PLUGIN FOR MAYA | ARNOLD

SIMULATE SMALL-SCALE LIQUIDS IN BIFROST

Utilise Bifrost's powerful tools to create realistic small-scale liquid simulations in Maya



AUTHOR

Holly Watt

Holly has eight years of experience as a freelance VFX artist, and is a lecturer at the University of Lincoln. [instagram.com/hollywattvfx](https://www.instagram.com/hollywattvfx)

This tutorial will guide you step-by-step through the workflow of utilising Bifrost's powerful tools to create a small-scale simulated liquid. Bifrost is well known for its use in creating large-scale simulations and it can often be overlooked when it comes to smaller, more detailed simulations.

The tutorial is aimed at complete beginners to Bifrost as well as those who have previously used it before for large-scale simulations. Bifrost is heavily dependent on the scene, so there is a focus on scale throughout the tutorial beginning with how to set up your scene to scale ready to add Bifrost emitters, colliders and

killplanes. The next steps cover how to alter settings needed to convert Bifrost from using a metre scale to a cm scale. You will then go on to learn how to create a viscous honey liquid simulation, how to cache your simulation and finally mesh it to turn it from particles to geometry. The final steps cover adding your shaders and lighting to create a simple but striking final image.

Once you've completed this tutorial you will have created a detailed, realistic simulation of honey and will have a thorough understanding of the Bifrost workflow, able to apply your new knowledge to create other small-scale liquid simulations.

01 MODEL YOUR SCENE TO SCALE

Bifrost relies on accurate scale to create realistic simulations, so you need to make sure the scale of your geometry that the liquid interacts with is correct. Research

the dimensions of your objects in real life; product listings on online stores is a good place to find accurate dimensions. A teaspoon is approximately 11cm in length, so working with a scale of 1 Maya unit equals 1cm, scale your image planes to 11 units for the length before you begin modelling. If you choose to download a free 3D model be sure to scale it to 11 units in length.

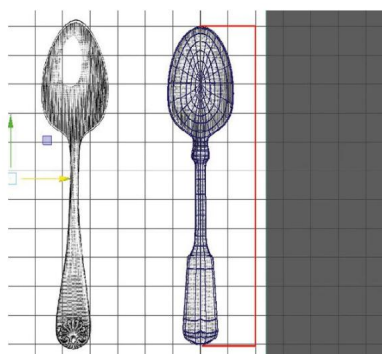
02 LAYOUT THE SCENE

Now that you have your spoon geometry modelled to the correct scale, you can layout your scene. Duplicate your spoon so that you have at least two and position them one above the other. The liquid will drip from above the camera view onto the top spoon ➤

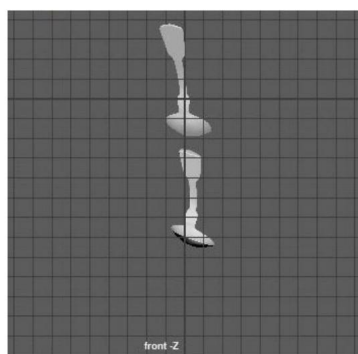


DOWNLOAD YOUR RESOURCES

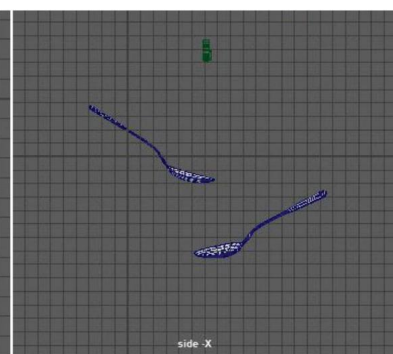
For all the assets you need go to <https://bit.ly/3DW-mandalorian>



01



02



➤ and fill it before dripping to the next. Add some variation to the rotations of each spoon to allow the liquid to have some interesting movement when it is time to simulate; you can always tweak the positioning later.

03 CREATE A RENDER CAMERA

Create a camera that you will render from and position it so you can see both spoons in the view. It's important to choose a lens that would work well in real life, so aim for something between 80-135mm for a close-up shot. At this point it is a good idea to set your image size in the render settings too; for test renders the settings were set to width 500 and height 750 (the final image size was increased but kept the same aspect ratio).

04 PLAYBACK SETTINGS

Before you begin to simulate there are a few preferences that need to be set so Maya can simulate correctly. In Maya Preferences go to the Time Slider settings and set your Playback Speed to 'Play every frame' and the Max Playback Speed to 24 or 25 fps x 1. This ensures that Maya doesn't skip over any evaluations on frames (if this is left at the default of 24 fps x 1 then Maya will playback at this speed and won't be able to calculate your simulation). Set your time slider to a length of around 300 frames.

05 ENABLE BACKGROUND PROCESSING

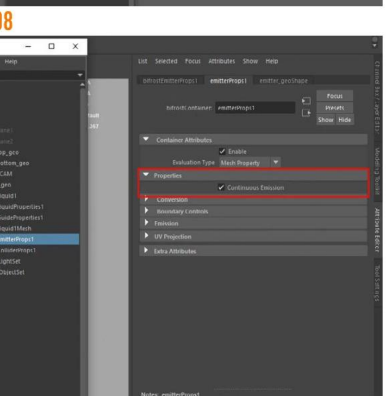
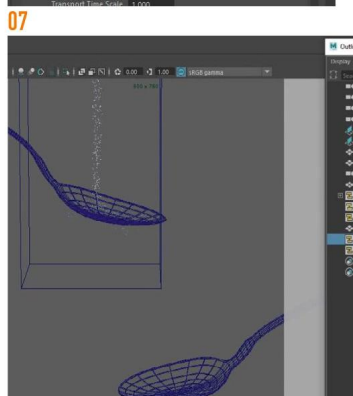
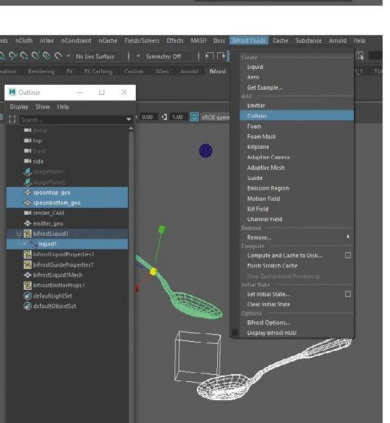
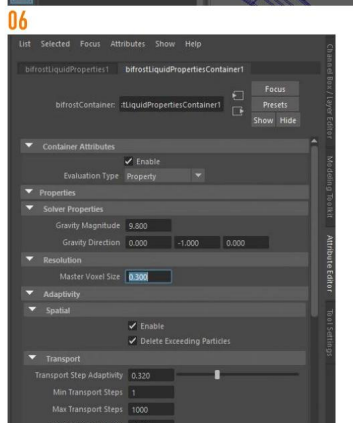
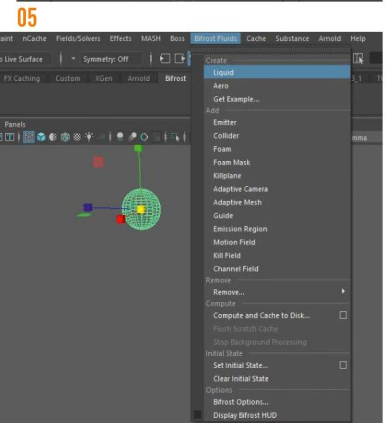
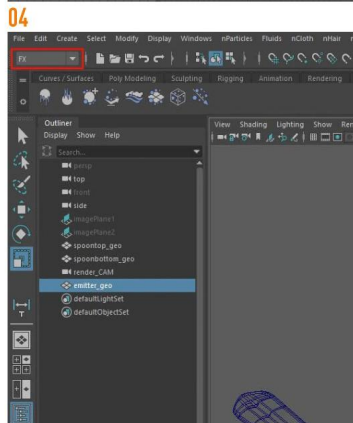
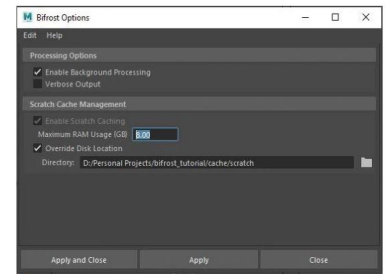
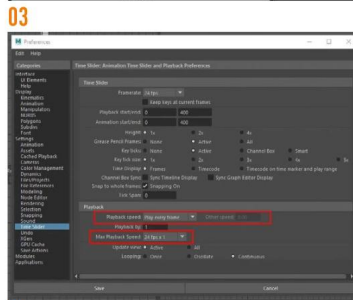
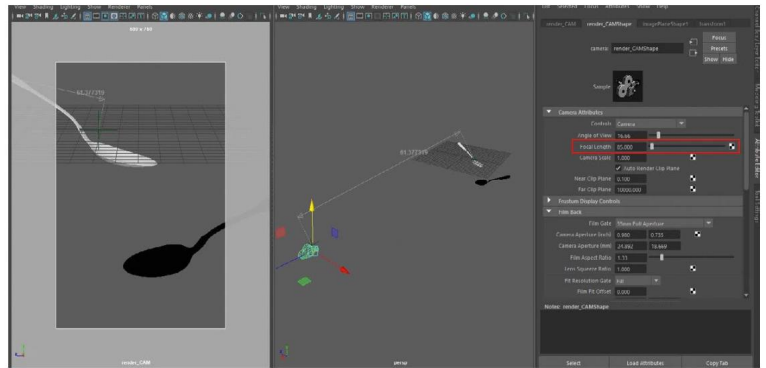
Before you create your Bifrost liquid it is useful to enable Bifrost to use background processing. Go to Bifrost Fluids in the Menu Bar and select Bifrost Options. Tick Enable Background Processing. Choose a Maximum RAM Usage about half of your computer's RAM, and select a Disk Location with plenty of space. When you hit play Bifrost will cache your simulation in the background, allowing you to preview frames that have already been completed. The scratch cache will be deleted if you tweak a setting or close the scene.

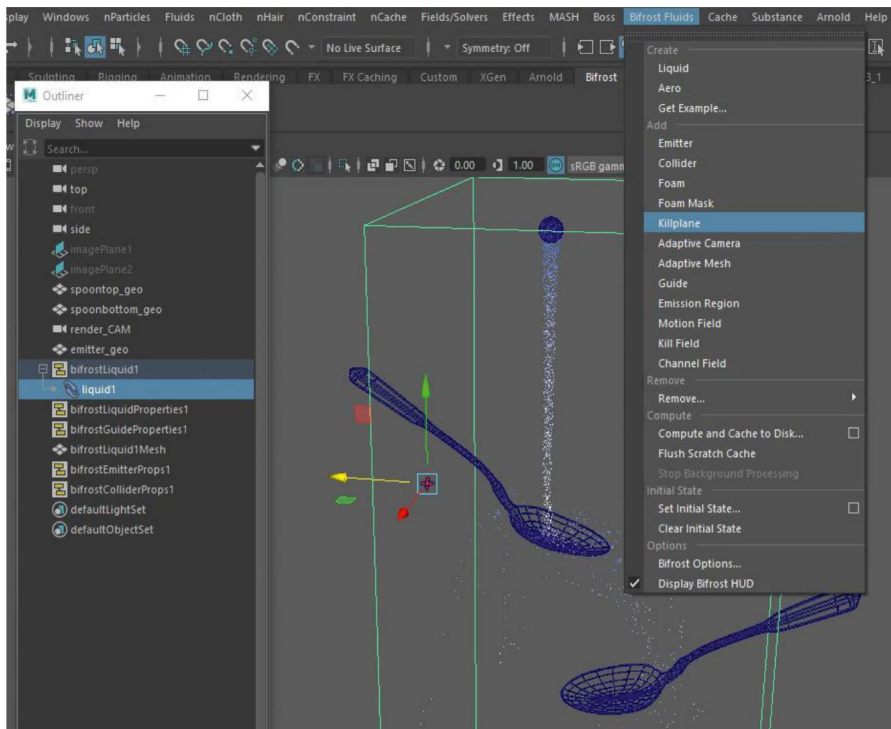
06 CREATE THE BIFROST LIQUID

First you need to create a polygon sphere that will be used as the

Distance tools in Maya

Maya has measuring tools found in its Create menu, which can be useful for getting instant feedback to easily check distances in your scenes.





10

emitter for our Bifrost particles; rename this emitter_geo. Scale this to the thickness you want the liquid to start as and position it above your spoon; 0.4 is the scale used here. With the sphere selected go to the FX context menu and select Bifrost Fluids and then Create Liquid. Maya will create a number of Bifrost objects in the Outliner. Hit play to check you can see the particles fall from the sphere. You may notice there are only a few particles.

07 EDIT THE MASTER VOXEL SIZE

Bifrost uses Master Voxel Size to determine the resolution of the simulation; a higher master voxel value means lower resolution but quicker simulations, and a lower master voxel value means a higher resolution (more particles) but a slower simulation. Ideally you want to keep the Master Voxel Size high for as long as possible, but for a small-scale scene you need to lower it early on to see more particles. Select your 'bifrostLiquidProperties1' in the Attribute Editor and set the Master Voxel Size to 0.3 for now.

08 CREATE YOUR COLLIDERS

The next step is to apply Bifrost collider properties to both of the spoons. Select your Bifrost liquid1 in the Outliner then

select both spoons. Go to Bifrost Fluids and in the Add section select Collider. Maya will turn your spoons into colliders and add a 'bifrostColliderProps1' object into the Outliner. To check that it's working press play and watch to see the particles disperse as they hit the top spoon.

09 TURN ON CONTINUOUS EMISSION

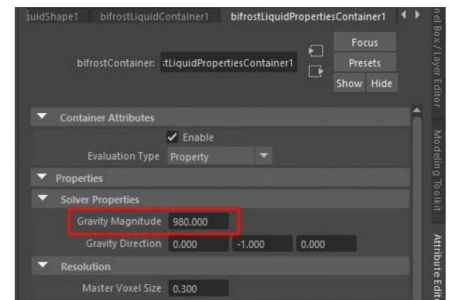
Bifrost is currently only emitting particles from your sphere on Frame 1, but to create the shot you need a continuous supply of liquid. Select your Bifrost EmitterProps1 in the Outliner. Then in the Attribute Editor under Properties turn on Continuous Emission. Now when you press play you will see a continuous stream of liquid emit from the sphere. Tweak the placement of the sphere geometry until you are happy with where the liquid hits the spoon when looking through the render camera.

10 ADD A KILLPLANE

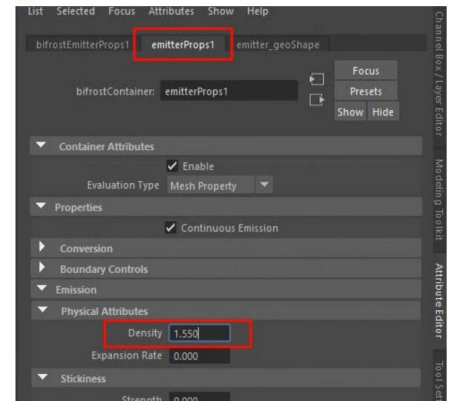
With continuous emission turned on the number of particles is rising each frame and will eventually increase your simulation time by a large amount. Killplanes will kill any particles that pass through them. With your Bifrost liquid1 selected in the Outliner go to Bifrost Fluids

Master Voxel Size

Keep the Master Voxel Size high while tweaking your simulations to gain quicker feedback, and reduce it only towards the point of your final simulations.



11



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in the menu and select Killplane under Add. Position the killplane under the second spoon just out of view of your render camera to kill any particles, as we don't need to simulate them once we cannot see them from our camera.

11 CHANGE GRAVITY TO CENTIMETRES

Up until this point no settings have been altered so Bifrost assumes our scene is still in metres. The first step to adjusting this is to edit the gravity value. The default setting of gravity is 9.8m/s², but as our scene is in centimetres we need to alter the value. In the Attribute Editor locate your 'bifrostLiquidPropertiesContainer1' and change the gravity magnitude to 980.00 (9.8m/s² = 980cm/s²).

12 ALTER THE LIQUID DENSITY SCALE

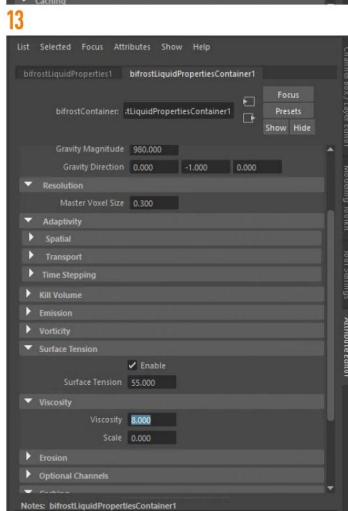
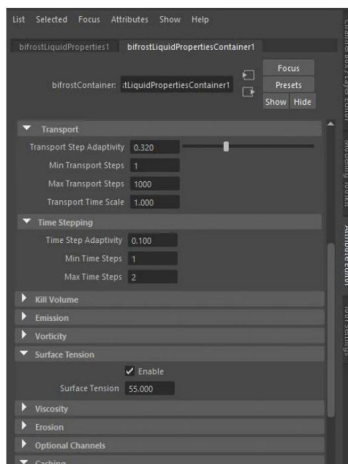
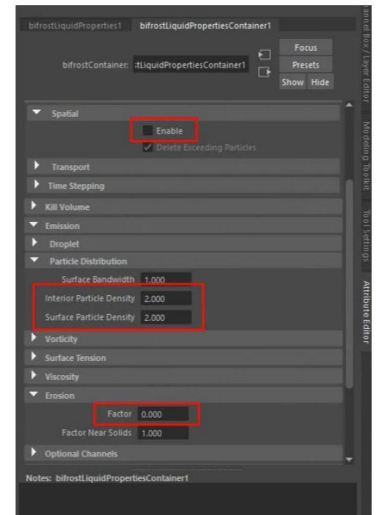
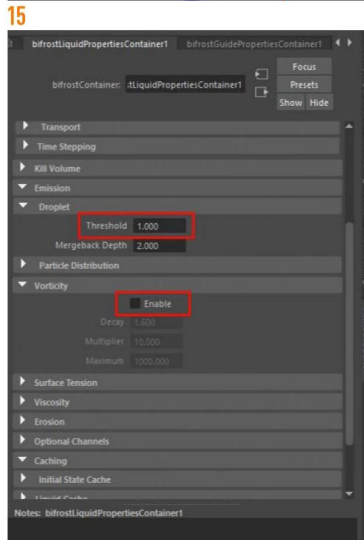
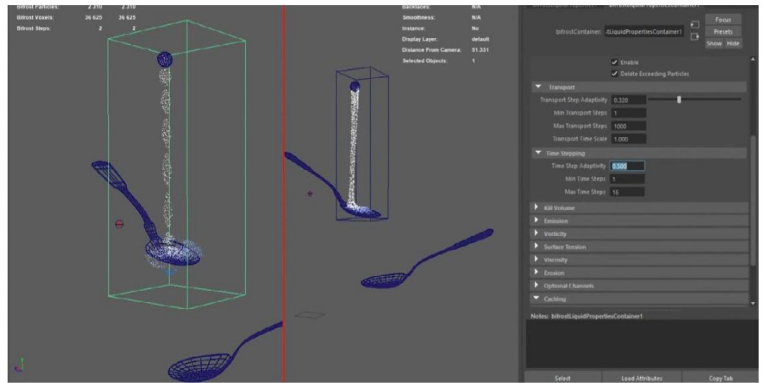
The next step is to alter the density of the liquid to reflect centimetres; by default Bifrost sets the Density to water which is 1,000kg/m³. To change this to a cm scale you need to set it to 1 for water. However, you are aiming to create honey for this simulation which is denser than water, so you will need to use a higher value for honey. To do this select your emitterProps1 in the Attribute Editor and change the

➤ Density from 1,000 to a value of around 1.55.

13 EDIT SURFACE TENSION The final setting to address to alter the default Bifrost settings to centimetres is the surface tension of the liquid. By default it is turned off, so first enable it in the 'bifrostLiquidPropertiesContainer1'. The default value of 0.072 is the surface tension of water in metres, so to switch to cm scale the value needs to be 72. As with the density you are simulating honey for this tutorial so the value should resemble honey, which actually has a lower surface tension than water – use a value of 55.

14 SET THE LIQUID VISCOSITY The next setting to adjust is the viscosity (thickness) of the liquid. The default value of 0 represents the viscosity of water for a scene scaled in metres. The viscosity value for water in cm scene scale is 1, but again you are simulating honey which is much more viscous than

Animate Transport Time Scale
You could consider animating the Transport Time Scale to produce a slow-motion effect, by speeding up and slowing down sections of your simulations.



water. In the Attribute Editor on the 'bifrostLiquidPropertiesContainer1' tab change the Viscosity value to 8 (real-world viscosity of honey). The particles begin to behave like a thicker liquid, but the liquid is moving far too quickly.

15 INCREASE CALCULATIONS PER FRAME

You will notice that the current simulation is leaving gaps in the honey drip; this is due to the number of calculations that Bifrost is computing per frame being too few. To fix this go to the 'bifrostLiquidPropertiesContainer1' and locate the Time Stepping settings. Change the Time Step Adaptivity to 0.5 (higher values mean more calculations per frame). Set the Max Time Steps to 16. Increasing both these values will result in more accuracy but longer simulation times; these settings will need to be increased later.

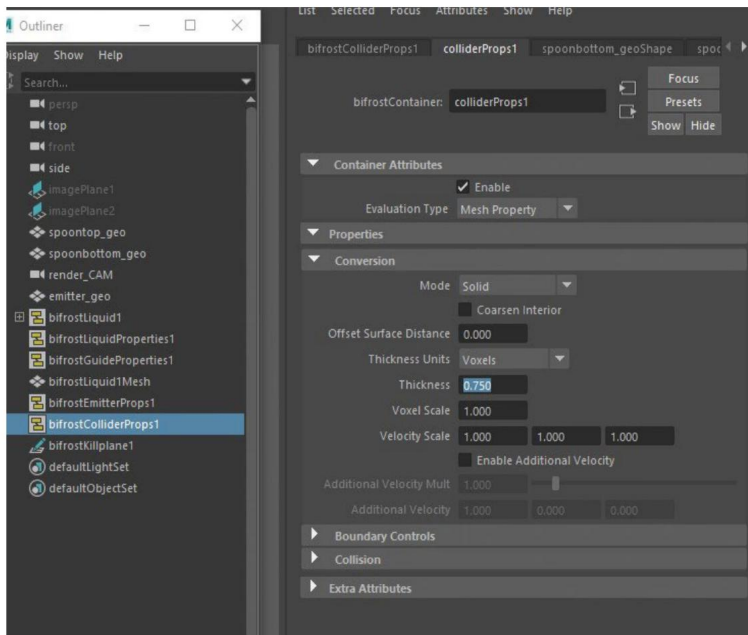
16 DISABLE LARGE-SCALE FEATURES

Now you have a basic simulation you can disable some features that

are useful for large-scale simulations only, such as waves. On the 'bifrostliquidpropertiescontainer1' set the droplet threshold to 1 (this disables Bifrost from splitting droplets of liquid from the main body of particles). Also disable Vorticity (this calculates the churning rotation of the liquid). Neither of these calculations are useful at this small scale or for the type of liquid, so by turning them off you don't waste unnecessary time calculating them.

17 DISABLE LARGE-SCALE ADAPTIVITY SETTINGS

By default Bifrost also has some adaptivity settings that allow it to skip some types of calculations when working on a large-scale simulation to speed up simulation times. But for this small-scale simulation it is useful to disable these adaptivity settings to provide more accurate calculations. On the 'bifrostliquidpropertiescontainer1' disable Spatial Adaptivity. Set the Interior Particle Density to 2 (these both disable Bifrost from using a lower resolution in the centre of a



Continuous Emission

You can keyframe Continuous Emission on or off by right-clicking on the Continuous Emission setting in the Attribute Editor and selecting Set Key. This allows you to turn the flow of liquid on or off at certain points in your simulations.

liquid). And finally set the Erosion Factor to 0 (erodes the particles at the point of collision).

18 ADJUST THE COLLISION THICKNESS

Review your simulation; you may notice that it appears as if the particles are floating on the surface of the spoon. This is due to the collision thickness that Bifrost is using. To adjust this select 'bifrostColliderProps1' in the Outliner. In the Attribute Editor adjust the Thickness value. Setting this to 0 adds no thickness to the surface but may result in particles passing through thin geometry. Try a value of around 0.5-0.75 for now, this can always be re-adjusted later.

19 SLOW DOWN THE LIQUID SPEED

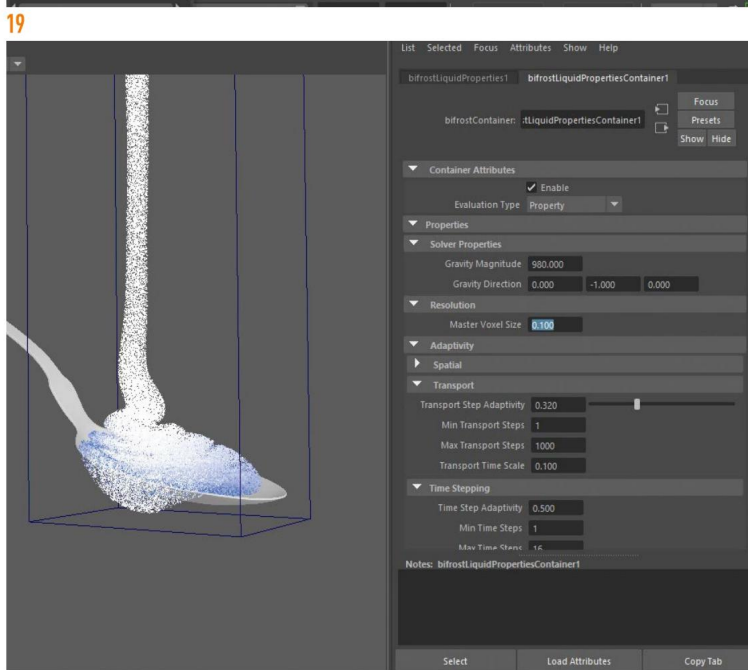
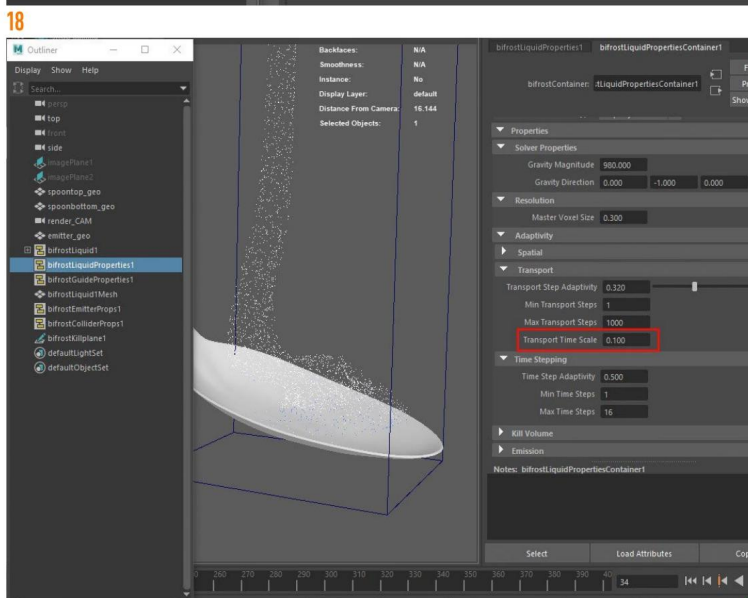
Now that all of the initial settings have been addressed you will notice that your simulation is still far from looking and behaving like honey. It is moving far too quickly, which is due to the scale of the scene and the gravity value. In order to slow the liquid down the Transport Time Scale on the 'bifrostLiquidPropertiesContainer1' can be used – change the value to a lower number to slow the speed of the particles down. You will notice that the liquid instantly begins to act more like honey as it folds over on itself.

20 ADD MORE DETAIL

Currently your simulation is still at a low quality with few particles, so there is a limit to how much detail can be simulated regardless of your liquid property settings. Now is a good time to lower the Master Voxel Size slightly before continuing to adjust any further settings. Be aware that altering this will slow down your simulation times considerably – be prepared to wait a bit longer for feedback on any changes you make going forward, but the payoff is that your simulation will now start to take on a more accurate, honey-like appearance.

21 MAKE ARTISTIC ADJUSTMENTS

Currently the simulation is using real-world values, however your



simulations only need to be based on reality, so spend some time doing some artistic adjustments by editing your Viscosity and Surface Tension values. Alter one value at a time, then re-simulate and playblast to check the results. Don't forget to also think about adjusting your geometry; the positions of your spoons and also the size and position of your emitter will have an effect on the simulation too. In this example the first thing that was tweaked at this point was the size of the emitter to create a thinner drip of liquid.

22 REVISIT TIME AND DETAIL SETTINGS

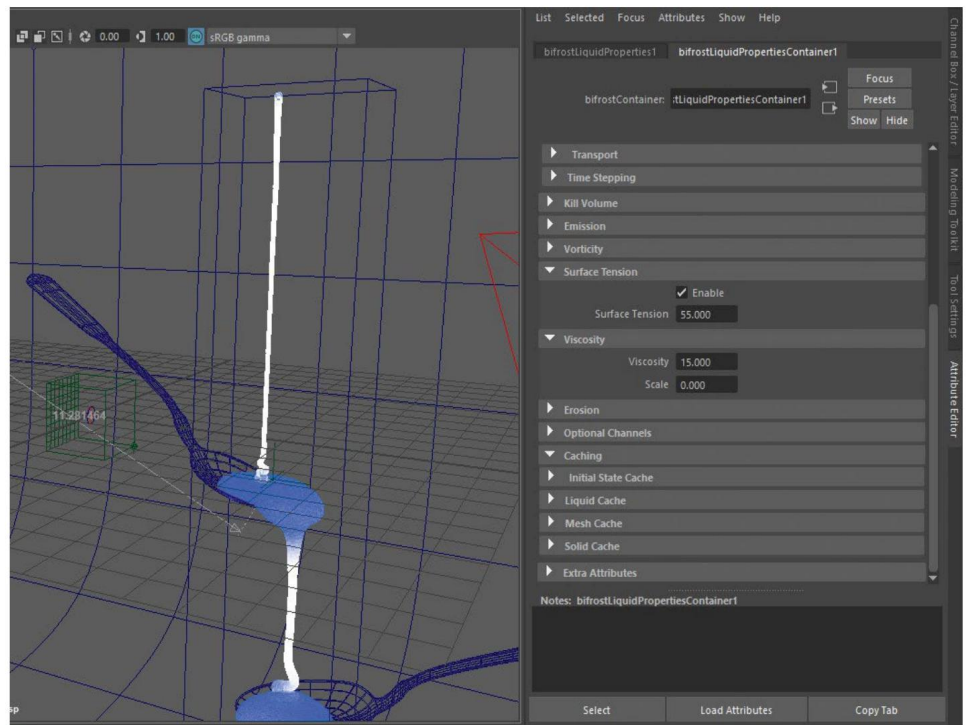
You may wish to also revisit the Transport Time Scale and Master Voxel Size at this point to further tweak the simulation. It will become a bit of a balancing act between adjusting these settings and the Viscosity and Surface Tension until a point where you are happy enough with the simulation to move onto the caching to disk, meshing and rendering stages. As with the previous step, try adjusting one setting at a time and then reviewing its effect. This will be a slow process, but worth it to get the best simulation you can.

23 ENABLE BIFROST MESHING

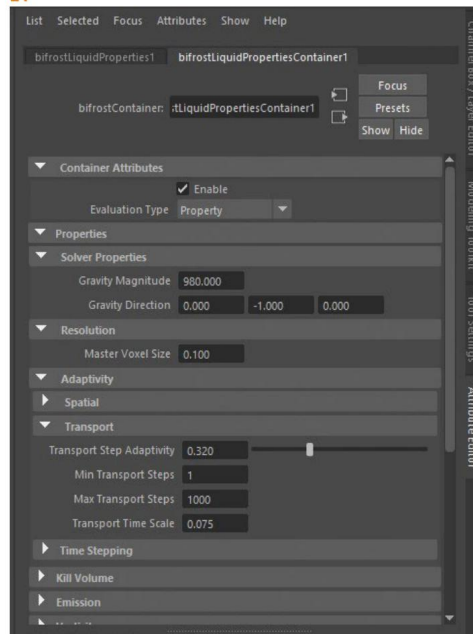
In the Attribute Editor locate the liquidShape1 tab and under Bifrost Meshing tick Enable; this will give you a preview of your mesh in the viewport. You can also turn off display particles on the same tab to help you see the mesh better. The settings you need to depend on your simulation settings, but pay particular attention to the surface radius, kernel factor and resolution factor when adjusting these settings for your mesh. Make sure to do some quick test renders to check that the shape of the liquid renders well, as it will appear different in the render to the viewport.

24 FIX MESHING ISSUES

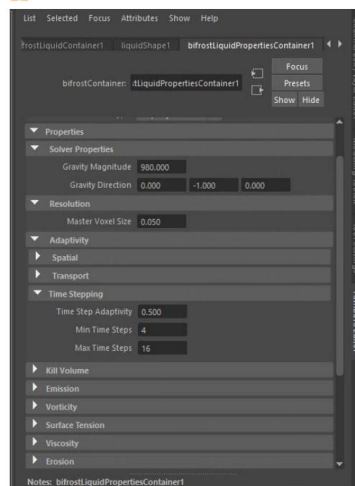
If you are seeing issues with the mesh such as stepping or faceting, it can be caused by the simulation not having enough detail. To fix these types of issues you may need to increase the number of Min Time Steps on the



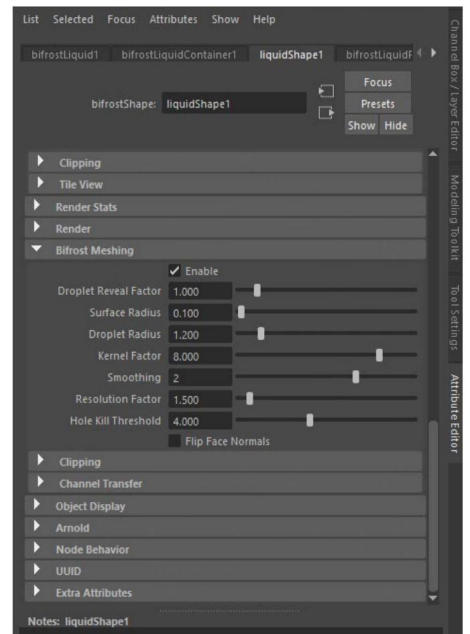
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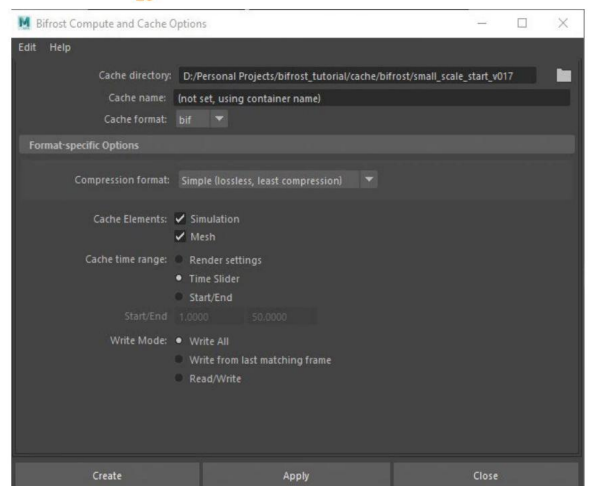
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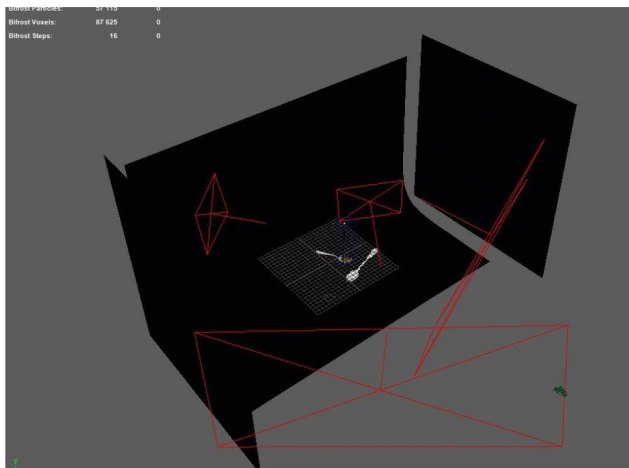
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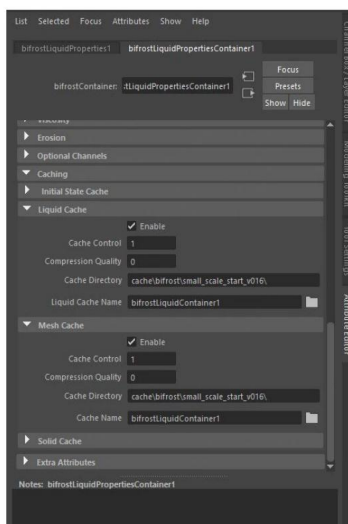


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'bifrostLiquidPropertiesContainer1' to force Bifrost to add more substep calculations per frame. Check your mesh again and if there are still issues you can also try increasing the Max Time Steps too; the values you need will be based on your individual simulation, but be aware that higher values will slow down the simulation.

25 CACHE TO DISK

Once you are happy with the simulation and mesh settings you can create a cache that is saved to disk rather than just the temporary scratch cache. Under the Bifrost Menu locate Compute and Cache to Disk and open up its settings window. Make sure to choose a good location with plenty of space. The default settings for cache format and compression format are generally sufficient. You can choose to output just the simulation and then cache the mesh separate or both at the same time. Make sure



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your bifrostliquid is selected and then hit Create.

26 READ IN A CACHE

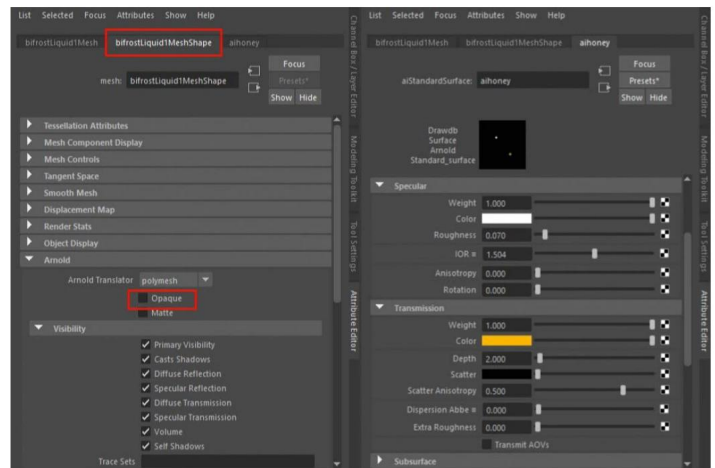
Once your cache has completed Bifrost will automatically read it in and you can review it, however if you did decide to tweak further settings after caching then you can disable the current cache on the 'bifrostLiquidPropertiesContainer1' tab in the Attribute Editor. You can also load different versions of your cache here if you wanted to compare different simulation settings. Before moving onto the rendering stage ensure you have your final cache loaded for both the liquid and mesh cache.

27 ADD THE LIGHTING

Now is a good time to create some lighting if you haven't already. You can choose to use whatever lighting you want to create the desired look. This example uses a basic studio setup of a backdrop with a three-point lighting setup. An additional rim light was added to highlight the initial drip against the black backdrop. Continuing on you will be completing the final lookdev by jumping back and forth between tweaking your shaders and your lighting, just like a normal workflow.

28 CREATE THE SHADERS

You will need to create your spoon and honey shaders at this stage. Your honey shader is applied to the bifrostLiquid1Mesh in the Outliner; this example uses an aiStandardSurface with the preset honey applied, however you can use any renderer you



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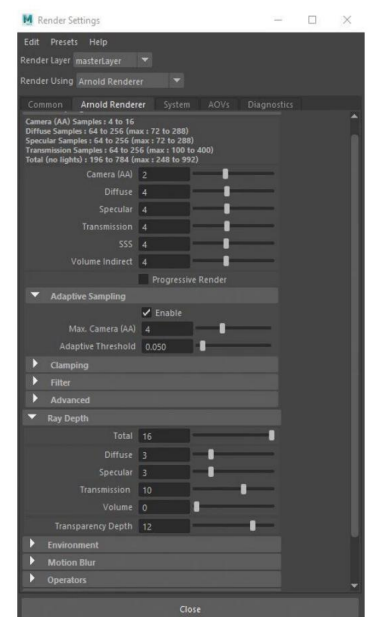
OpenVDB meshing

If you want to take your meshing one step further then look up tutorials on how to use OpenVDB scripts to create your mesh instead of using the Bifrost meshing.

choose. If using Arnold on the 'bifrostLiquid1MeshShape' of the mesh, uncheck Opaque in the Arnold section. For the shader set the IOR to that of honey between 1.484-1.504. Use the transmission settings to fine-tune the look of your honey shader until you are happy.

29 READY TO RENDER

Now that you're ready to render your simulation you will need to set your final render settings correctly. As you are using a transparent liquid, it is important that you pay particular attention to setting the Ray Depth values high enough to allow for the transmission of light through your liquid. Ensure you've set everything from the name to the resolution, and then batch render. You've now completed the workflow of creating a small-scale liquid through to its final render. •



29



FOLLOW
THE VIDEO

<https://bit.ly/3DW-mandalorian>



GRAVITY SKETCH VR | VR RIG

SUBDIVISION MODELLING IN GRAVITY SKETCH

Bring the power of subdivision modelling to VR design

VR creation tools have been around for a while now. As artists we can sculpt, sketch, layout, design, iterate, paint, animate and do a whole host of other cool tasks right inside our VR headsets (HMD). While most of the sculpting is done using voxel-based modelling, very much akin to using spray foam in the air in front of you, Gravity Sketch focused on a spline-based workflow that really suited CAD-based modellers, and you can easily see how automotive designers can benefit from that sort of technology in their day-to-day work.

But what about character and creature designers? Or artists coming from 2D and wanting more of an organic workflow? Well, as mentioned there is always programs like Oculus Medium (soon to be Adobe Medium) and Masterpiece VR that have focused on voxel sculpting. You can get amazing results in both of these, but what if you want more control? What if you want subdivision modelling in VR? That's what Gravity Sketch have been working on last year and the resulting new toolset inside the core Gravity Sketch program is amazing. Subdivision modelling has been around for well over 25 years now

and is the way that we can get rounded or smoothed shapes driven by a lower polygon model. It is how programs like Maya, Max and Cinema 4D (and pretty much all polygon modelling programs) allow you to make stunning models without the polygon count killing your machine. In this tutorial I go through the core toolset and how to use those tools to make a rhino beetle.



DOWNLOAD YOUR RESOURCES

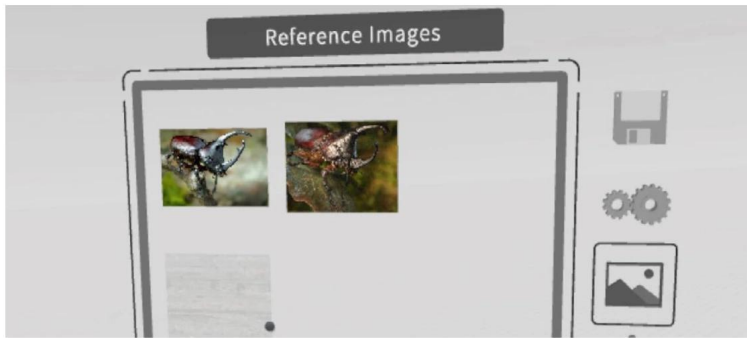
For all the assets you need go to
<http://bit.ly/3DW-mandalorian>



AUTHOR

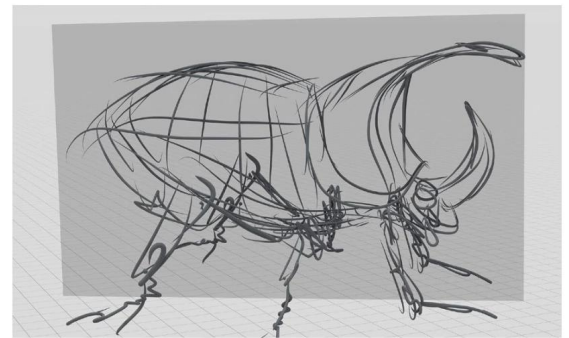
Glen Southern

Glen runs SouthernGFX, a small Cheshire-based studio specialising in character and creature design. He has been using and training ZBrush in the UK for over 15 years.
southerngfx.co.uk



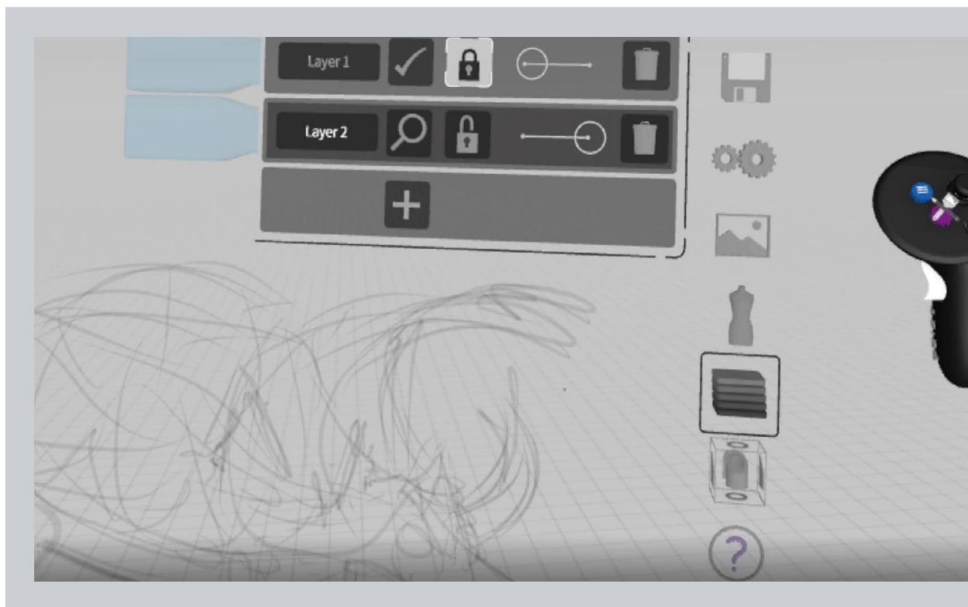
01 GET SET UP

Collect any reference imagery you might need and put it into the Gravity Sketch folder on your PC (usually Docs>Gravity Sketch>Reference images). Any JPGs or PNGs that are saved in that folder will appear in your interface. If needed, add them to the scene from the Reference Images icon on the non-dominant hand. You can add as many images as you need for the project and either hang them in the air in front of you or anchor them to the model you are working on. That way they move with the image as you are working.



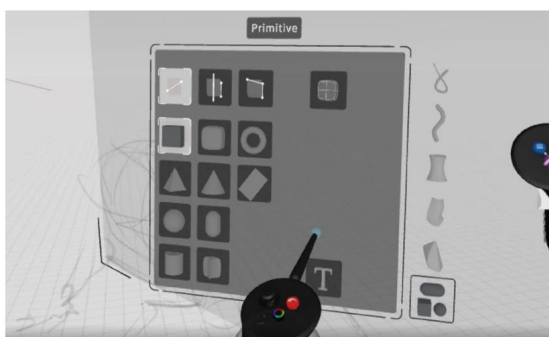
02 SKETCH OUT A REFERENCE MODEL

Once you have an idea of what you want to make, sketch out the entire model in a very fast and loose way. This helps to quickly establish scale and proportions of the design. Using the ink tool with mirror switched on from the main menu, sketch out a rough shape of the beetle. Keep it very fluid and sketchy and remember that this layer will be nothing more than a guide.



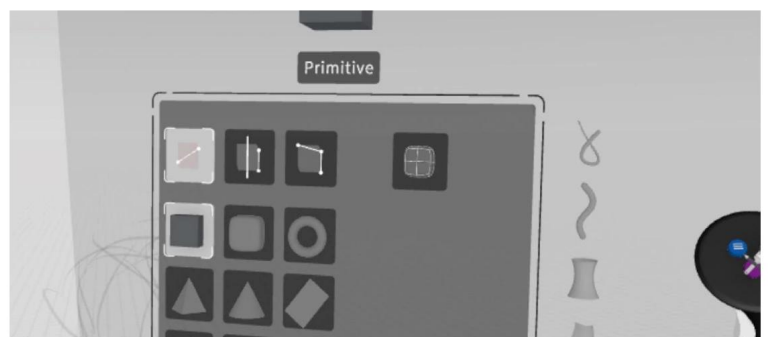
03 USE LAYERS

This sketch now needs to be made transparent and locked. From the layer menu (shown) add a new layer. Name it 'model' if needed but it's not essential. On the first layer with the sketch beetle, lower the slider to near the bottom of the scale and the layer becomes more transparent. Once you have it so you can hardly see it, hit the lock icon to stop you accidentally touching this layer in the future. Notice any reference material goes transparent too. You can always make more layers and add the artwork there if needed.



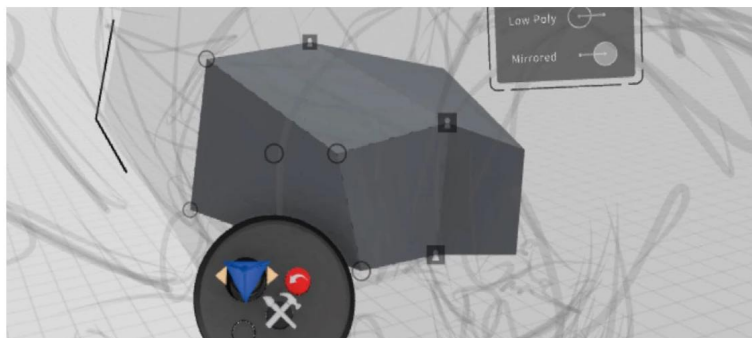
04 BEGIN A SUB-D MODEL

The developers added the Sub-D features into the Gravity Sketch interface alongside the existing tools. Any of the basic model components in the Primitive menu can become Sub-D objects. For this exercise click on the cube and then the Sub-D cube (top right). Back in VR click to add the cube to the scene. Press the blue button to activate the Sub-D menu and then click Mirror.



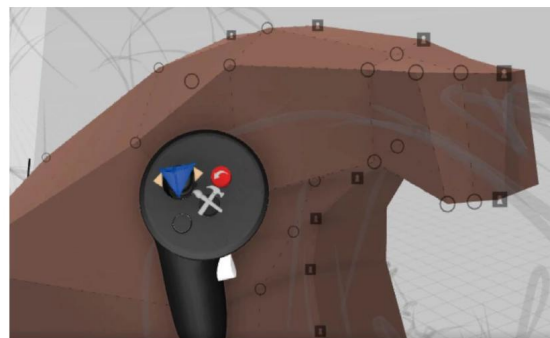
05 MIRROR ACROSS THE AXIS

After you have activated the Sub-D mode (blue button) you will notice that the cube now has small circles on the corners. These represent the vertices that are part of the main component parts needed to make geometry (vertices, edges and faces being the main three). To change between these modes flick left or right with your dominant hand thumbstick. To snap these points to the centre seam simply drag them across until they snap. Do all four on the cube and this removes the inner polygon faces.



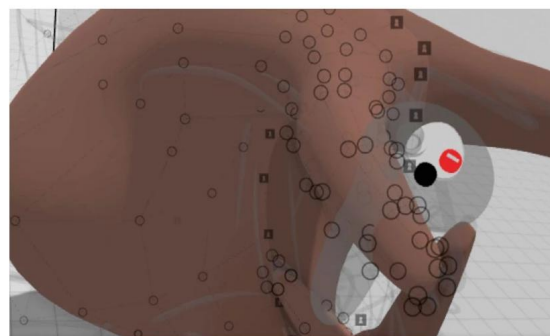
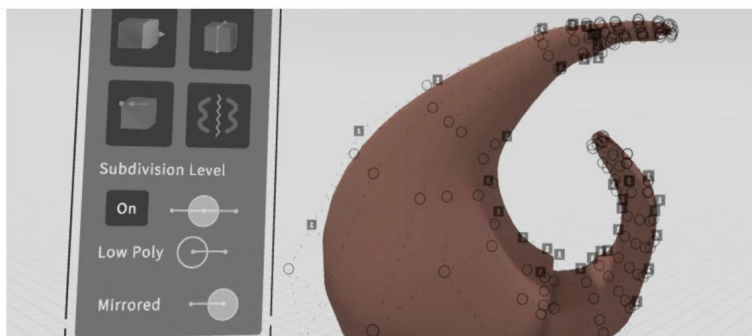
06 BEGIN THE HEAD

Drag the cube until it is in line with your line sketch. Start with the head at the base and work up the top horn first. To move a single point (vertex) make your grab area bigger or smaller by pushing on the thumbstick. Whatever the grabber covers with the coloured sphere can be manipulated. To move one point, make the sphere small. To move several increase the size accordingly. Move individual points, edges or even whole faces and try to get used to switching between the modes (point, edge, face) with your thumbstick.



07 EXTRUDE POLYGONS

Flick with your thumb to enter face mode. Make the grabber smaller than a face and just get used to moving faces in this way. As you are moving a face, if you fire with the trigger you will extrude outwards once. By using the grip on the non-dominant hand you can move, extrude and scale in one fluid movement. Remember the red button is undo!



08 SUBDIVIDE

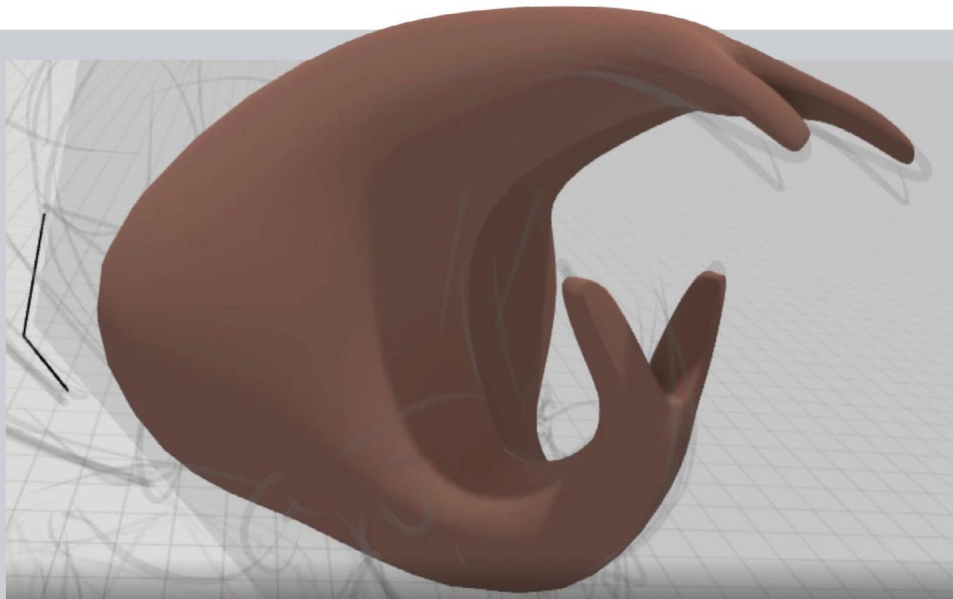
To take advantage of the smoothing algorithms of subdivision modelling you need to activate them. When you press the blue button a panel will appear if you are on a Sub-D model. In that panel you can activate the mirror and choose some options for the model. The sliders at the bottom are the things to focus on. You can active Sub-D (on or off) from here and also set the level of Subdivision. At this point turn it on and just slide up one level. If you go too high you may get into difficulties depending on your system.

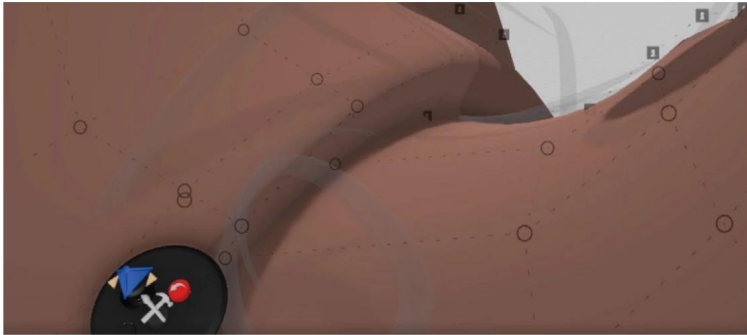
09 SHAPE THE TOP SPIKES

Now continue extruding once you reach the top of the horn. Extrude out sideways as the horn forks outwards. Extrude a couple of times and turn Sub-D on and off to see how the underlying polygons look. If you get edge loops too close together you will get a crease effect, so go back if needed. Make the last extrusion and make that final polygon much smaller.

10 FORM THE REST OF THE HEAD

Now that the top horn is formed you can go back to the middle of the head and do exactly the same workflow but work down the underside of the head along to the face area. Take it step by step and extrude a section, then tweak those points until the shape is correct. Then move on to the next extrusion. The bottom forked horns are pretty much an inverted replica of the top as you can see from the reference. Remember to turn Sub-D on and off to see how your underlying cage is looking.





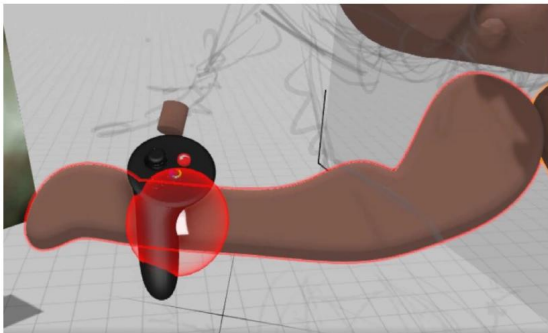
11 EDGE LOOPS

Wherever we want a creased area we need to add more edge loops. Hover over the area just behind where the eye will be going. Flick with your thumb to edge mode. Now if you are hovering over an edge and you press with the trigger, you will add a complete edge loop around the model, presuming the loop doesn't break further down the line. Go back to vertex mode and tweak the points by dragging them down and under the preceding loop. You can see it better in Sub-D mode.



12 ADD AN EYE

The eye is little more than a sphere and there are two ways to add one. Access the primitives panel once again and if you click the sphere then drag into the scene, you get two mirrored spheres. If you activate the Sub-D icon (top right) after selecting the sphere you will get a polygonal sphere that can be used in Sub-D mode as the rest of the model is being used.



13 CREATE AN ANTENNA

Click the volume tool (found on the menu on your non-dominant hand) and access its settings. Change it to planar and it will only make a shape on a single plane. Draw out the shape of the antenna and it will fill the space, creating a solid shape. This is great for roughing out volume but can sometimes cause issues when you export it, so use it sparingly.



14 PLACE ON HEAD

We can model most parts of this project in space away from the main creature, and then bring them in and locate them on the head. As you had mirror switched on, the antenna is composed of a left and a right model. As you move the one you made, you will notice that a mirrored copy is moving on the opposite side. Rotate and scale the antenna as you locate it on the side of the head.

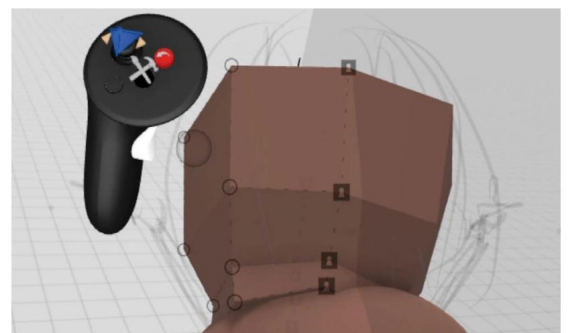
Soft Selection to adjust geometry

Soft Selection is a way to adjust a group of points but with a falloff as the area gets bigger. When off the model, hold the Grip button. Push up and down on the thumbstick to make an inner sphere smaller and bigger to get more or less effect.



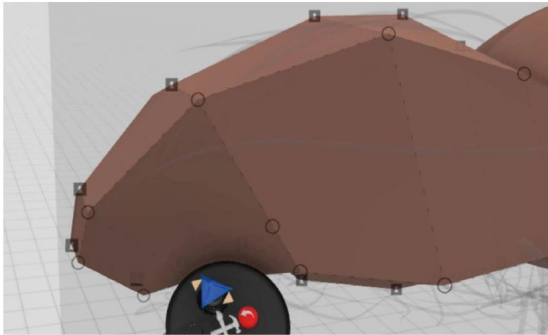
15 MAKE THE BODY

Access the primitives menu again, select a cube and then activate Sub-D as you did for the head. You may want to experiment with the other shapes at this stage, but if you still need more practice the cube is a great way to get started for most modelling jobs. Once the cube is in the scene, move it towards the back of the head. This is going to be the abdomen and wing casing all in one piece. Make sure all the points are snapped together across the mirrored seam.



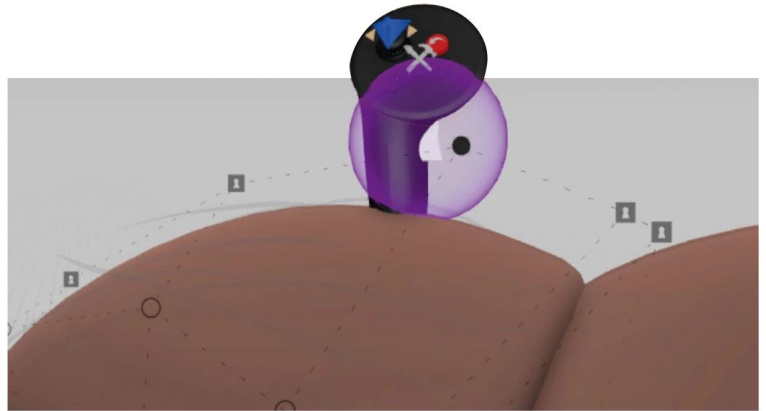
16 SHAPE IT

Hit the blue button and enter Sub-D mode. In point mode begin to move the points around to shape the backend. Place the grabber over the polygons at the back and extrude out and backwards a few times. Then flick back to point mode and tweak them into a rounded shape as shown. If your grabber covers more than one polygon you will extrude everything that you cover.



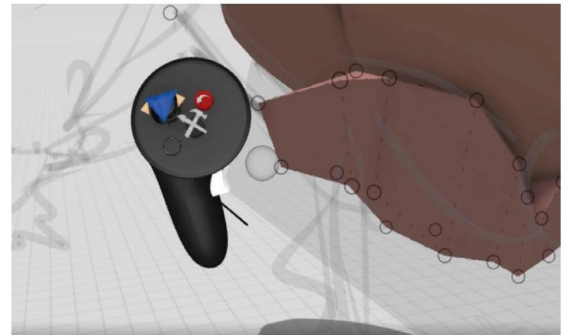
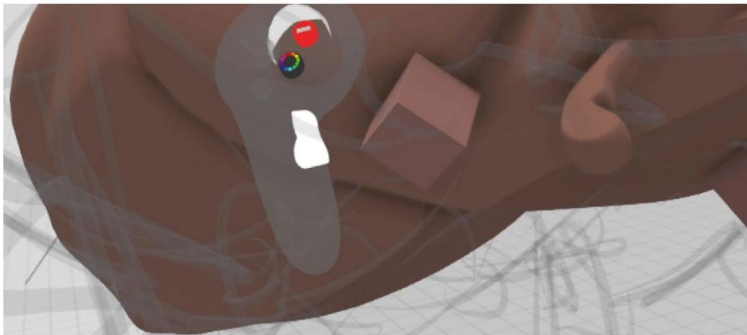
17 KEEP IT LOW POLYGON

When doing this sort of modelling it is best to keep everything as low polygon as possible, and keep switching Sub-D on and off to see how the overall shape is looking. As you can see the back of the beetle doesn't need many polygons to hold a really nice curved shape once in Sub-D mode. Add more loops vertically to make a tight curve going underneath the shell.



18 SHAPE IN SUB-D MODE

Because subdivision modelling is using a low-polygon cage to drive a high-polygon mesh, you can manipulate the complex shape when in Sub-D mode by simply moving one point (vertex). Work your way around the backend and make sure you are looking from all angles. It is easy to make the model look great from the side then realise that you don't have enough volume in an area or a bad curve. This is one of the great things about working in virtual reality, it is very easy to judge shape and form from all angles.



19 MOVE ONTO THE LEGS

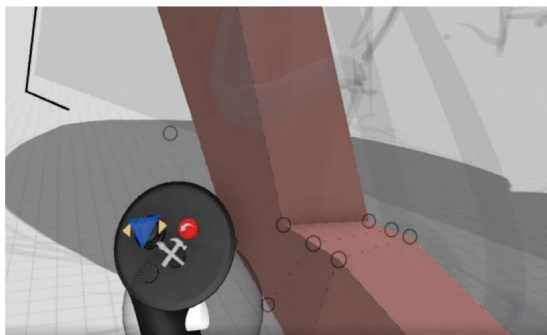
The beetle sketch shows that we need the usual six legs as with most insects. In the same way that we have done all along, start with a Sub-D cube. Locate it underneath the body just at the back of the head. We will extrude out and down to begin forming the first leg in the set. Remember to have mirror activated so we are making both left and right at the same time. Extrude the leg in sections and add loops at all the main joints. As you do a section switch to point mode and tweak the overall volume.

20 SHAPE THE LEG

If you switch to Sub-D mode you can see that you are essentially extruding out a cylinder. Make sure that you add extra edge loops that go around the cylinder (cube) at the joint areas. The joints need to be tight and sharp. Increase the size of your grabber to cover the whole joint and pull down on the thumbstick to smooth out the area. Always check it in and out of Sub-D mode.

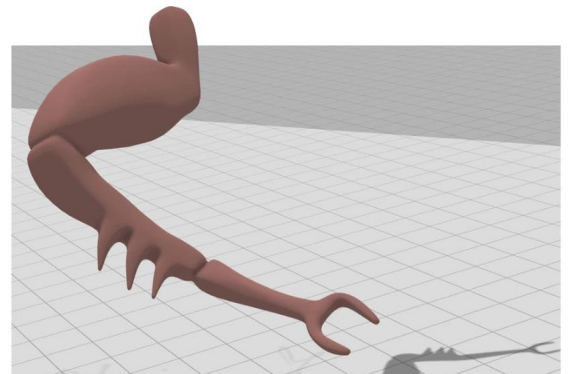
Splitting loops

To add more polygons you can split loops around your model. Hover over an edge in edge mode and use the trigger button. Be careful not to add too many.



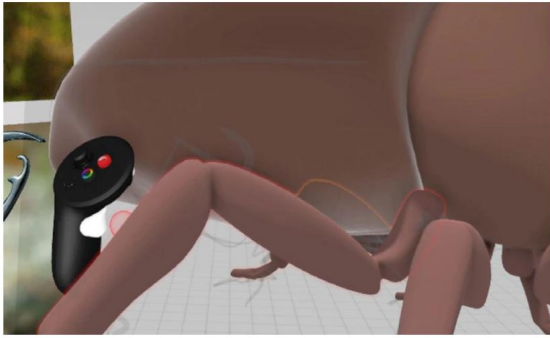
21 THE TIPS

Most beetles have what are termed tibial spurs, which are spikes on the end of the last but one segment of the leg. Then there can be tarsal segments. To emulate this we can extrude out small spikes along the bottom of the leg. Make sure there are enough edge loops in this section for this. When you extrude each one make the end smaller, so as you subdivide it will look tight and sharp.



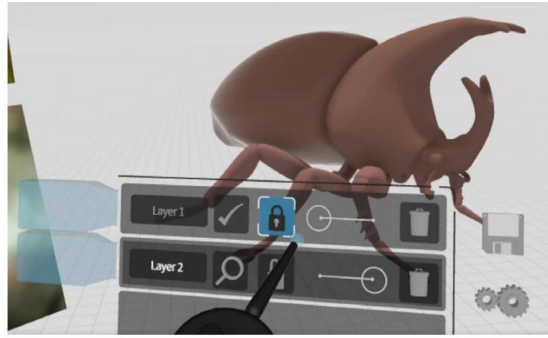
22 REFINE THE SHAPE

All of the legs are basically the same number of segments, just in a different shape and orientation. We will duplicate the second leg and make a third. Create a second leg in the same way as you made the first, but make the second one angle out more and be more upright. Make sure you have the legs at the correct angle and that the feet are on the floor.



23 LAST LEGS

Once you have the second one laid out you can duplicate it and make a new copy. To do this you can grab the leg so that you are holding it in your dominant hand. If you now click the trigger button on that hand you will drop down a new copy of whatever you are holding. Position this and the legs are done, and the whole model is now complete.



24 CLEAN UP THE SCENE

You can now go back to Sub-D mode and make sure everything fits and is the correct size and position. Delete the layer that we used as a reference. If you don't do this you will find that all sorts of data you don't want will be exported with the beetle. All of your strokes would get converted to geometry, and that would make the scene messy when you import it into another program.

Use other tools

On your dominant hand controller you will see a button for more tools. From here you can access a smooth tool, a combine tool and a knife tool for redirecting your polygon flow.



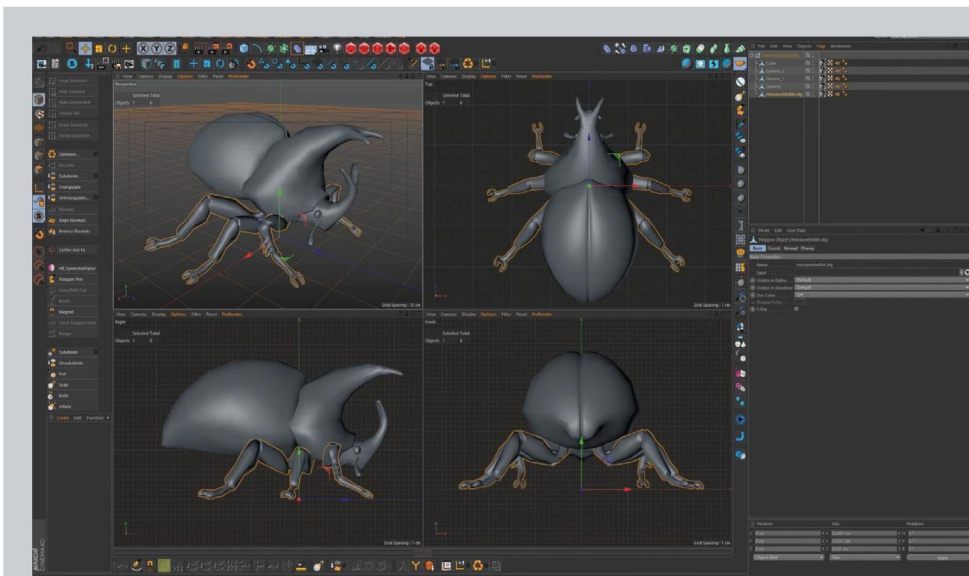
25 BEFORE EXPORTING

There is a real watch-out to be aware of before we export this model. Go through each part of the model and make sure Sub-D is switched off. If you don't, the model part will be exported at the subdivision level that it is on during the export. Essentially, you would end up with a high-poly model and will not be able to go back to the low-poly version. Of course, you may want a higher-resolution version, so set it as you need. Save the model from the main menu before we head to exporting.



26 EXPORTING MENU

On your dominant hand there is a menu for exporting. There are options for exporting OBJ, FBX and IGES. To send to a polygonal modelling program like Maya, Cinema 4D or ZBrush you need to use either of the first two. Choose OBJ and keep all other settings as default for now. Save the model on your hard drive or to the cloud.



27 IMPORT INTO ANOTHER PROGRAM

Go to your render program of choice. Use the import function and bring in the rhino beetle OBJ. You can now check over the geometry and make sure it is oriented correctly for that program. Rotate and scale it as needed. For this example I used Cinema 4D, and Redshift as the renderer. Most programs have a way to subdivide the model at this stage. In Cinema 4D it is done by dropping the model into a HyperNURBS tag. Choose your materials and render away to your heart's content. ●

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SUBSTANCE DESIGNER | MAYA (OPTIONAL) | V-RAY (OPTIONAL)

CREATE BLUEBERRIES PROCEDURALLY IN SUBSTANCE DESIGNER

Learn how to replicate complex natural patterns and shapes to create realistic-looking blueberries

Substance Designer can be overwhelming when it comes to creating fully procedural textures, and we can often be stuck questioning ourselves. Questions such as, how can this pattern be made efficiently, and how do we start? There's no specific set of steps and no fixed rules to follow when you're creating in Substance Designer. One thing that's important is that everything is kept flexible and as simple as possible to reduce overhead and keep things logical.

Organic materials in the real world are naturally formed and can often share similar patterns. These patterns often contain some sort of symmetrical details, vein-like edges and cracks, tessellated and repetitive shapes, and corners or angles with splits at 90 or 120 degrees. Recognising

these similar patterns will help us figure out how to recreate these patterns easily. Once we can confidently recreate these patterns, approaching any organic surface becomes much less of a challenge and a more fixed logical set of steps.

This walkthrough will be going over various methodologies and steps to follow that can help you to recognise and create complex shapes and patterns with ease. Not only will we be going over how to create these patterns, but how to easily break up and remap them for controlled variations in our textures.



AUTHOR

Matthew Novak

Matthew Novak has worked across many disciplines including modelling, texturing/shading, FX, lighting, and is currently a CG supervisor at Scanline VFX in Vancouver, Canada.
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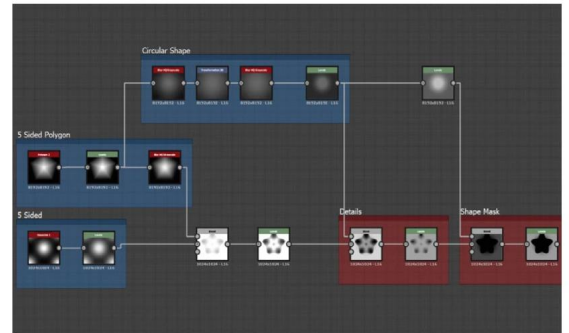
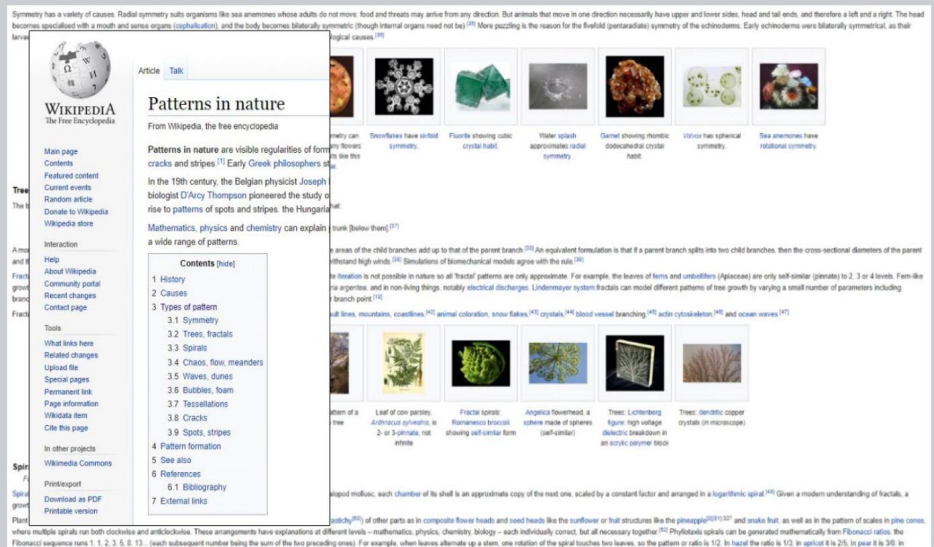


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01 RECOGNISE PATTERNS

In order to replicate patterns in a more procedural way, we should become familiar with some of the common patterns seen in real life. Creating a blueberry in Designer can be very similar to creating a starfish, honeycomb, snowflake and other patterns. These patterns are just a varying combination of geometric shapes, lines and fractals, all of which are then duplicated symmetrically to form more complex patterns. Once we can visually break this down, it becomes a much easier task to create challenging shapes that may seem complex but are actually quite simple.

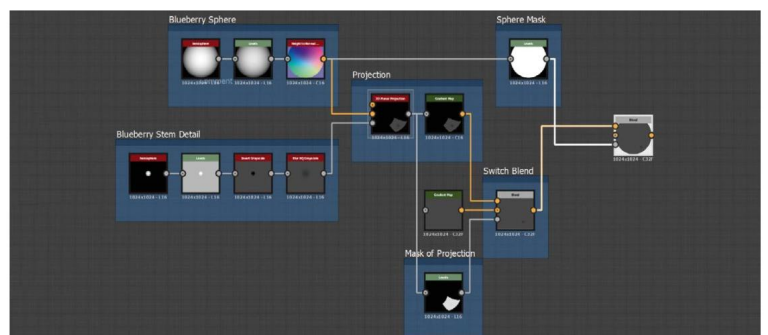


02 BREAK THEM DOWN

Since we are wanting to create a blueberry, we should find a lot of reference and try to deconstruct any complex patterns into simple processes. For example, by looking at this reference we notice a couple of key things that make up the shape and details of the blueberry. First of all, it's shaped like a sphere, and it has a flower-like detail/inset on the top which is somewhat geometric/star-shaped with five sides. Its backside has a stem that connects through a tiny indent.

03 COMPLEX PATTERNS MADE SIMPLE

Now that we logically understand this pattern, we'll start with a five-sided polygon and blend (set to divide) it with a Gaussian pattern to give us some more complex shaping, cutting away from the five-sided polygon to reveal a more detailed shape. We can then continue to blend and adjust this shape to result in a mask that can be useful later on when we need to isolate this area.

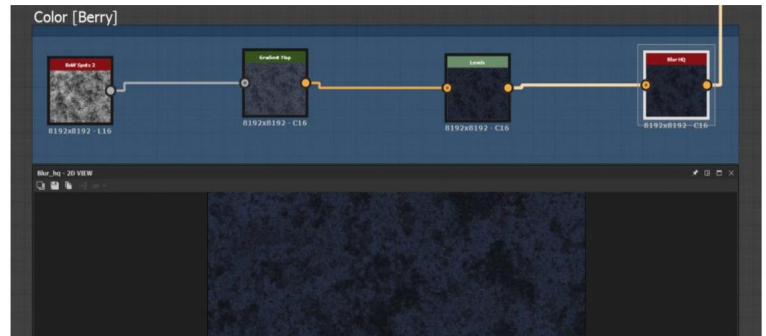
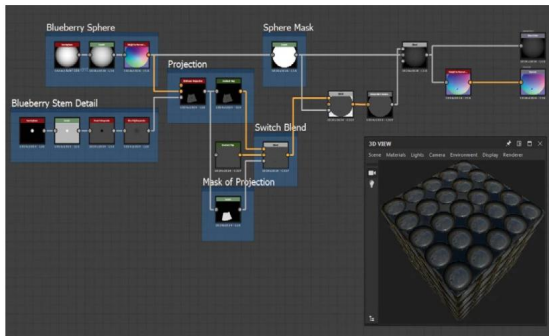


04 RECOGNISABLE FEATURES FIRST

As much as we want to focus on the complex shapes and details, we should also remember to get the easy and recognisable stuff out of the way. The sphere shape of the blueberry along with where its stem connects are details that are extremely simple and should be blocked in or completed at an early stage. This can free our mind up to focus on more challenging details.

05 WRAP UP THE BASIC SHAPES

To fully develop the shape of the blueberry we will take our details, the overall shape (sphere) and project the details onto the sphere. This will give us control to manually place the details or vary them procedurally. Create a 3D Planar Projection node (Projection Input set to UV) and connect the normal of the sphere/hemisphere to the Worldspace Normals input, and the detail we want to project into our Projected Texture input. Then create a switch blend with a flat colour and a mask to make sure it combines everything seamlessly.

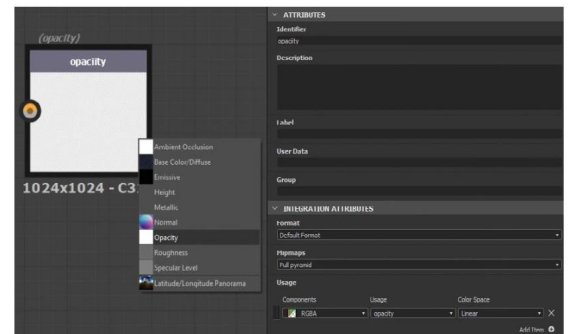
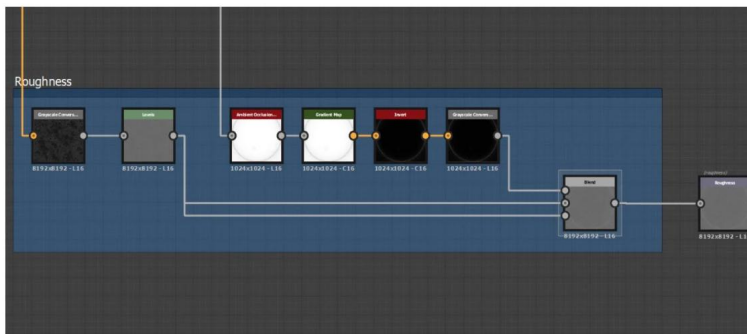


06 CONTROL FOR PLACING DETAILS

At this point it's not a bad idea to preview the shape converted to normals: to do this we use the sphere before we flatten it to a mask so it still has gradient shaping. We blend (mode: multiply) it with our projection result and use a height to normals node (adjusting the height as needed). View this with tessellation/height if possible to make sure the shape is formed properly.

07 COLOUR PATTERN

Next, the most iconic thing about a blueberry is its spotty blue/purplish colour. This is probably my favourite step since it's so straightforward. We can find a procedural pattern or mix one ourselves; in this case, the 'B&W Spot 2' procedural works really well, connecting it to a gradient map to sample its colour based on a ramp that we can sample from an image, or adjusting the gradient ourselves. Once the colour looks right we can just add a very subtle blur so the procedural details don't seem too rigid or unnatural.

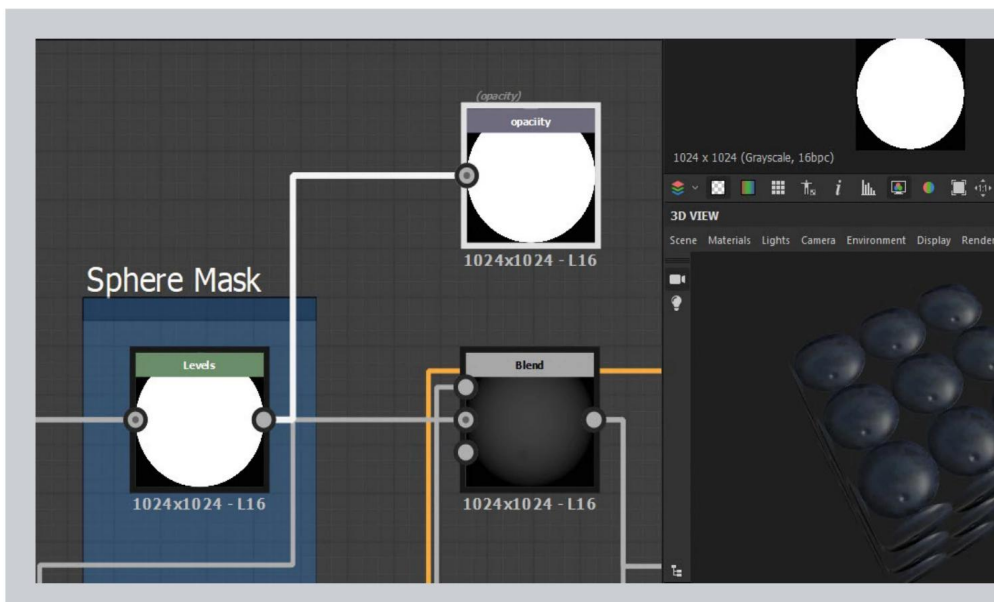


08 BLUEBERRY ROUGHNESS

One of the most important parts of any texture is the roughness/glossiness. Since blueberries are fairly smooth but often contain slight surface imperfections, dust or residue, they may be not as glossy or smooth as when they have just been washed. So the roughness can vary, however we will set it to something that looks appealing and believable. Since the goal is to map this blueberry texture onto texture cards or shapes, we will next set up our opacity map to allow the gaps in between the berries to be transparent.

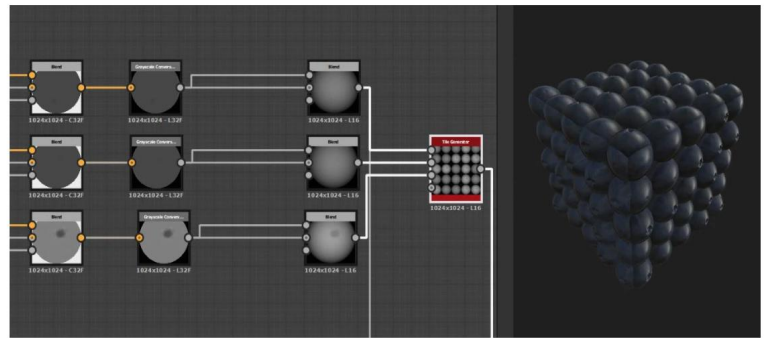
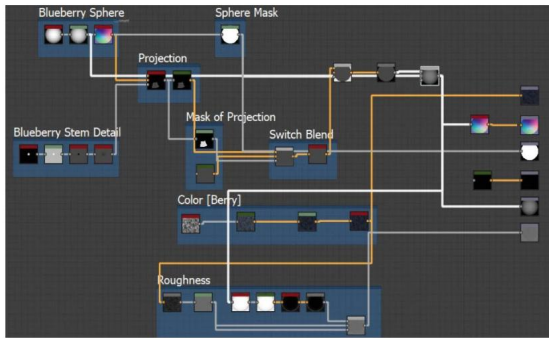
09 CREATE OPACITY/TRANSPARENCY

To set up an opacity map in Substance, we first create an output node and then define what type of map this should be, by adding an item under components under the usage section. Right-click this output node, click view in 3D and select Opacity. Also make sure to change the identifier name of the output node to Opacity so it's organised and labelled correctly.



10 BLUEBERRY OPACITY

For the actual opacity and transparency around the edges of each blueberry, we will simply use the circle/sphere mask for our blueberry from earlier. Sometimes a bit of a blur can help the edges if they are feeling a bit too sharp, but this is really all we need for now. Later on we will have to revisit our connections when we start tiling different variations of blueberries, but first we should complete all these initial steps and then worry about adding variations further down the line.



11 PUT IT ALL TOGETHER

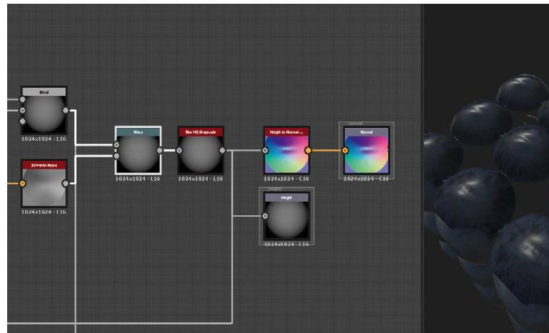
So now that we have most components of this blueberry done, once we put all these things together we should end up with a pretty solid network and workflow to create a blueberry. But we are not done yet, now is the time to go back through the network and dial things in a bit better as well as duplicate our projection nodes to make different variants of the blueberry.

12 TILE THE BLUEBERRIES WITH VARIATION

Once we have our variations we can start plugging them into a tile generator to give us a more randomised grid of blueberries. This starts to feel a bit more realistic. We will have to add tile generators to all output nodes and make five-by-five blueberries to get a good amount of variation. At this point, it's a good idea to go over your graph and eliminate any unnecessary nodes, or just add some comments to group things better in order to keep our node graph organised.

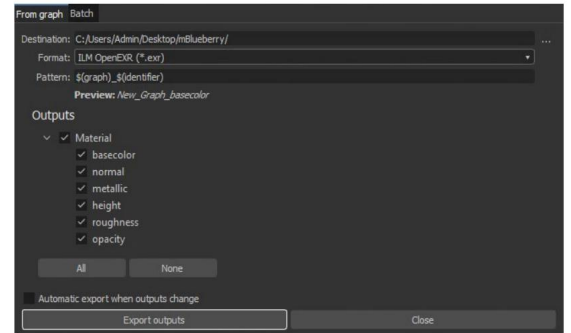
Think about roughness details

Remember that shapes can sometimes affect roughness, for example the small crevices in blueberries can capture more dust or dirt and will have more roughness/softer highlights. Cavity or occlusion maps can be used to mask these areas.



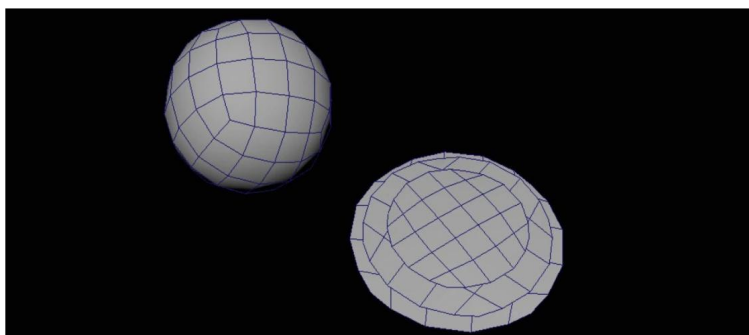
13 FINE-TUNE HEIGHT/TESELATION

This helps if we add a bit of variation in the height/displacement for each of the berries so they don't all appear the same size. For even more realism adding slight distortions on each berry can help, and this can be done with a warp and a noise using the sphere normal as our position input for the noise. This can emulate small surface imperfections and overall randomised shaping.



14 EXPORT MAPS

Finally, to export everything out we should ideally export our blueberries at the highest resolution we can, then afterwards scale it down to the desired resolution and save out to the file format we need. Usually this ends up giving us the best results with the sharpest details, even though it will end up taking a bit longer to export or generate.



15 PUT THIS TEXTURE TO USE

Once we have the maps exported it's just a matter of bringing them into Unreal or Maya with your choice of renderer. Connecting the maps into a material and of course setting up the displacement is fairly easy since most of it was fine-tuned inside Substance Designer, so there's not much if any lookdev or additional shading work that needs to be done. This can also be applied to a stack of rotated cards or a stacked shape to emulate a basket or a pile of blueberries.



16 THE RESULTS

Of course games will have more limitations and it would be advised to use lower texture resolutions inside any real-time renderers. But if we do export high-resolution textures with displacement/height maps and set it up inside of a ray-traced renderer, the result is quite impressive. Substance Designer can produce some amazing and flexible textures for both games and film. •



Photos from Vertex 2020. The event featured Loish, Karla Ortiz, Izzy Burton, Goro Fujita and so many more! We'll announce speakers for 2021 very soon.



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3DS MAX | CORONA RENDERER | SUBSTANCE PAINTER | MARVELOUS DESIGNER

PRODUCE A WARM ATMOSPHERE

Give your interiors a warm tone with the effective use of lighting, colour and composition

In this tutorial, we will take a look at how to create a simple realistic scene. To start off, we need a great architectural design, then some high-quality assets and textures for making our design more realistic. After that, we will use a combination of lighting, colour harmony and composition to create our desired final look.

01 MODEL THE ROOM AND INTERIOR

As you can see, this project only requires some simple modelling; you just need to know about dimensions in architecture to

model this room. After creating the room it's time to arrange the furniture. Some assets were purchased from 3dsky and Evermotion and the rest modelled by me. Next we'll place our models in the scene. I wanted to depict the inside as warm and the outside cold, so I used a fireplace in the room and for outside I made the weather rainy.

02 FABRIC

For the fabric I used Marvelous Designer. First, I exported my collision object with OBJ format, then in the 2D scene

I created a 100*50cm rectangle for my fabric and in the 3D scene, I moved it. For controlling your fabric, click the simulation button. For better simulating you can decrease particle distance. For exporting, consider the scale of the object. After importing to 3ds Max, you should optimise your fabric by using ProOptimizer.



DOWNLOAD YOUR RESOURCES

For all the assets you need go to <https://bit.ly/3DWWorld-mandalorian>



AUTHOR

Amir Mohammad Nabavi

I was born in 1996 in Qom, Iran. I actually graduated in electrical engineering – very strange, I know! But I've always loved art. amir-nb.cgcommunity.org



01

03 HAIR AND FUR

For hair, I used the Hair and Fur modifier. In the Dynamics parameters, you can simulate that in Live mode. Just click on Live and you'll see the hair start moving based on the Dynamics parameters. When you've got your desired result, just press Esc and then click freeze. After that, I used Styling for further tweaks.

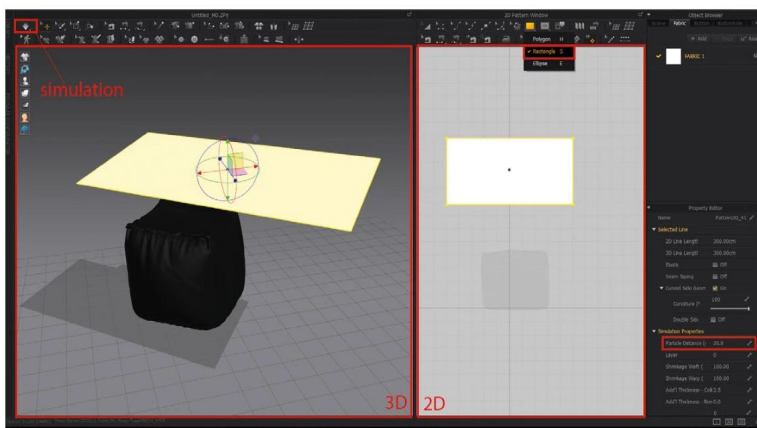
In General Parameters, there are many useful options; you can see my settings in the image below. Remember to set the Hair and Fur

rendering option to 'mr prim' in the Environment and Effects window.

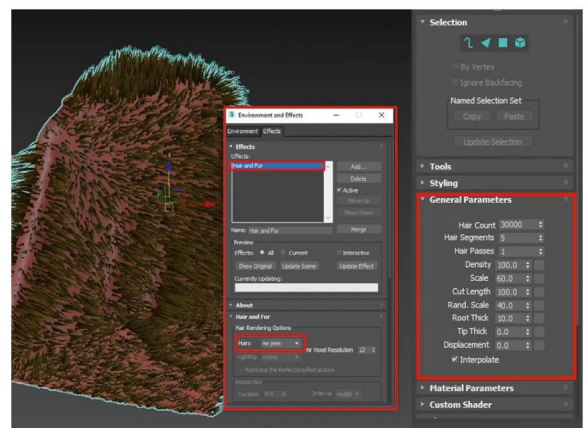
04 LIGHTING (EXTERIOR)

The first thing to do is use 'Mtl. override' in the render settings, but preserve the Light, Portal and Glass.

I wanted to create a sunset atmosphere so I used a nice HDRI for the environment map; remember you can use the Corona Color Correct map to change gamma and exposure of your HDRI. After my initial test render >



02



03

➤ I wanted to have more blue light in the room, so I did two tweaks: adding a portal object and a rectangular Corona light behind the window with 35,000 Kelvin! For the exterior background I used Corona Light Mtl.

05 LIGHTING (INTERIOR)

The important point here is to mix cold and warm light; if you check pro renders you can see this contrast a lot. For interior lighting, I used some halogen light (IES) and a rectangle light for above the bed. One of the best features of Corona is light mixing; you can activate it from the render settings, so now you can change the light settings after rendering!

06 SHADING

If you want to create realistic materials you need a PBR workflow. Using PBR materials means using textures with maps for most of the channels, like reflection, normal map etc. So for concrete I used PBR textures, and you can see the material settings in the screenshot.

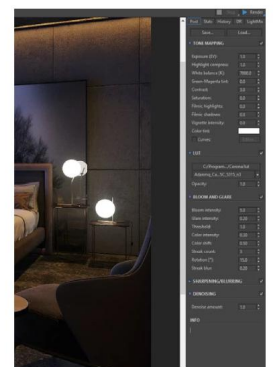
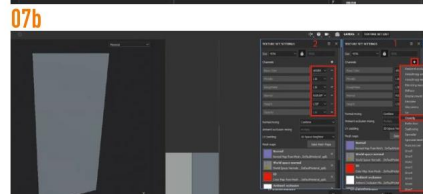
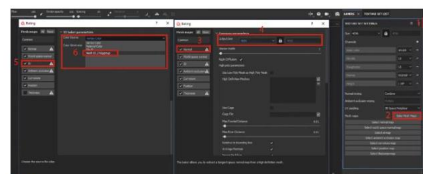
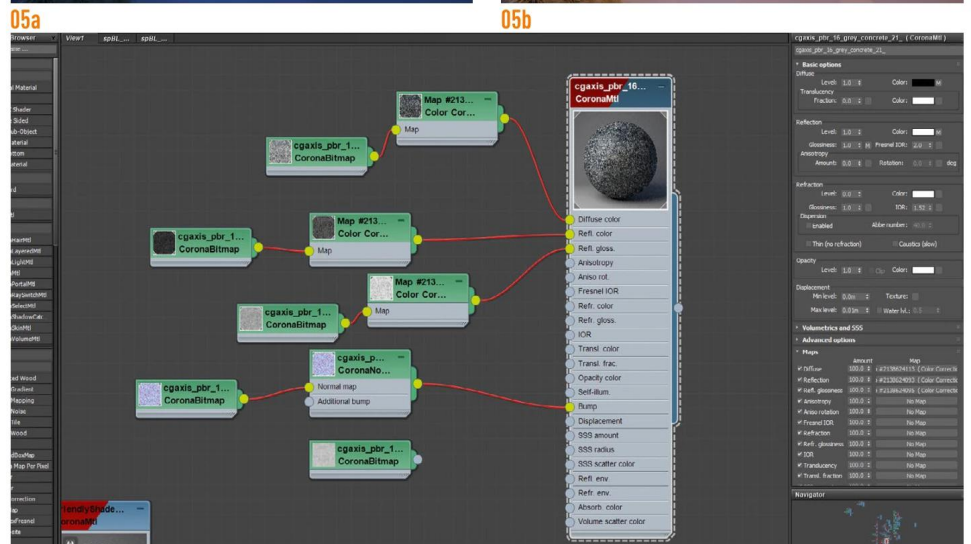
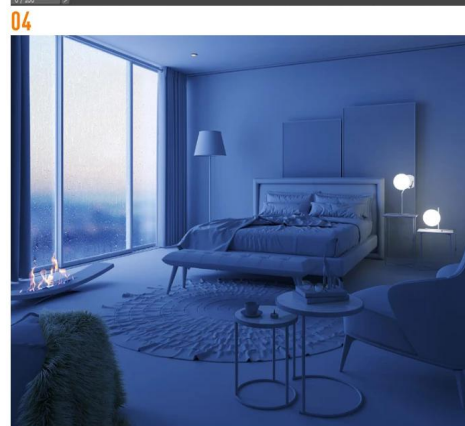
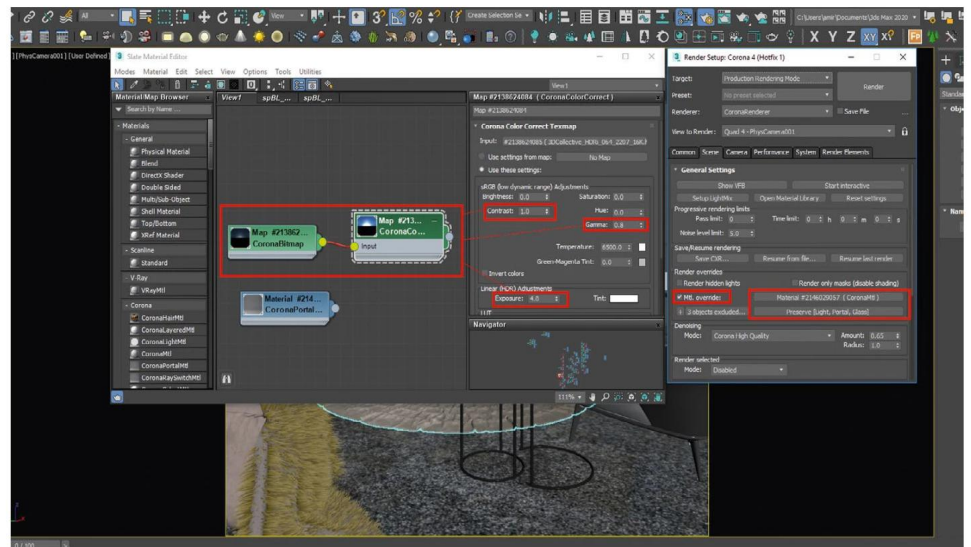
For creating a rainy window there are different methods: you can use pre-made raindrop textures, but here I used Substance Painter which gave me a good result. First, you should unwrap your object for importing to Substance Painter.

07 WINDOW SHADING

After unwrapping the window, you need to export it. In Substance Painter, I changed the shader settings for creating glass material. Then I baked my model – it gives you useful map channels. Next create a fill layer for basic glass material, activate 'op' and deactivate the 'nrm' option. Now I want to add raindrops, and for that I used MatFX Water Drops. For exporting textures with opacity channels consider adding Opacity in the Texture Set Settings.

08 POST-PRODUCTION

Corona Renderer has a powerful frame buffer and helps us use Photoshop less. I set Contrast to 3 and Temperature to 7,000 and used bloom, glare and sharpening. I also used LUT which helped to make my design really beautiful. •





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Artist Q&A

Practical tips and tutorials from
pro artists to improve
your CG skills



Maya Jermy

Maya is a 3D artist and animator based in the UK.

She started her career in 2012 remaking and animating characters for *Oddworld: Abe's Oddysee - New 'n' Tasty*.
mayajermy.artstation.com



Antony Ward

Since the early 90s Antony has worked for many of

today's top game and VFX studios, and has written three technical manuals and many online tutorials.

www.antcgi.com



Pietro Chiovaro

Pietro is a freelance 3D artist and YouTuber. An

expert in the creation of game assets and environments, he shares many of his creations on his channel.

www.pietrochiovaro.com



SOFTWARE: ZBRUSH

WHAT'S AN EASY METHOD FOR CREATING SCALES IN ZBRUSH?

Graham Larsen, Kent



Maya Jermy replies

There are lots of ways you can create scales for armour, reptiles or other subjects. You could create an alpha, a 3D brush or simply sculpt them on. If we want to find the quickest solution though, we should think about using MicroMesh. This is a BPR render feature in ZBrush that allows you to replace each polygon of a base mesh with a selected PolyMesh model. It generates a clean and pretty even distribution of the projected tool at a maximum speed, and is a fantastic way to create very detailed renders in an instant.

MicroMesh can be adjusted or changed at any time until it is turned into

a PolyMesh, which is incredibly useful and time saving. You may not find yourself needing that tool often, but it will prove very useful when you do. Once you get the hang of it, I am sure you will start producing your own original creations or improving your old projects that will benefit from this super-quick technique. You will find excuses to use it a lot to design more impressive and eye-catching details in your work.

To show you how quickly you can achieve quality results, we will take a look at creating a dragon egg. It is a perfect example to help you understand how this tool works and what can be achieved with

GET IN TOUCH

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rob.redman@futurenet.com



Just think of all the precious time saved by MicroMesh creating these eggs

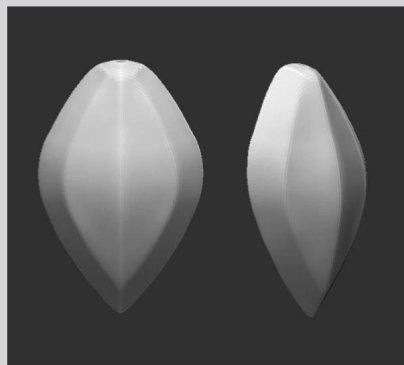
it in a few simple steps. Fantasy fans can easily describe a common dragon egg: it is covered in scales that resemble the scales of a grown-up dragon, and they are usually shiny, in a variety of colours, and look as if they were made of precious metals – take for example the dragon eggs from *Game Of Thrones*. The scales can have sharp edges for protection, or be shaped in many unique ways. Their final look is only limited by your imagination. We will make something of that kind and it will not take us much time at all. Plus, the good news is that we only have to create one scale that will get automatically instanced during the process, so let's begin.

EXPERT TIP

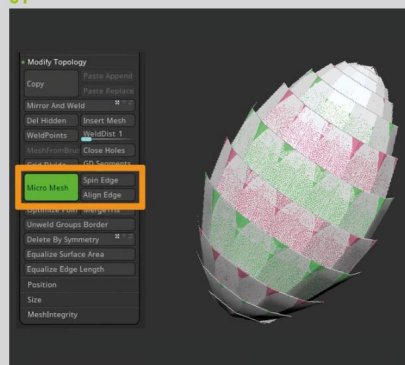
FIBERMESH AS BASE

If you find yourself using MicroMesh with FiberMesh, bear in mind that FiberMesh will stretch your MicroMesh along the whole length of every fibre, despite the number of segments.

STEP BY STEP CREATE A SCALY DRAGON EGG IN FOUR STEPS



01



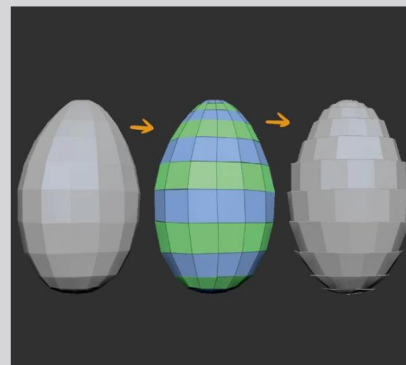
03

01 JUST ONE SCALE

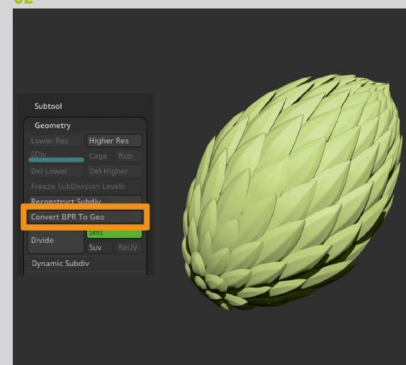
Create a base mesh for the scale; it's best to have it low poly (with UV map) and high poly for projection. You may have to keep in mind the polycount of the low-poly model – it will multiply by however many instances you end up producing in the end. Save the tool.

02 SIMPLE MESH GUIDE

Create a mesh guide. In a separate project we will create a low-poly egg. Each polygon will turn into a single scale we have created. First build a general shape of the egg, and keep it low poly. Then, polygroup every other poly loop and separate them for easier mesh manipulation. Move the loops so they overlap but do not intersect. I used the Split To Similar Parts tool for even easier control over each poly loop, then merged them back together after adjusting their positions.



02



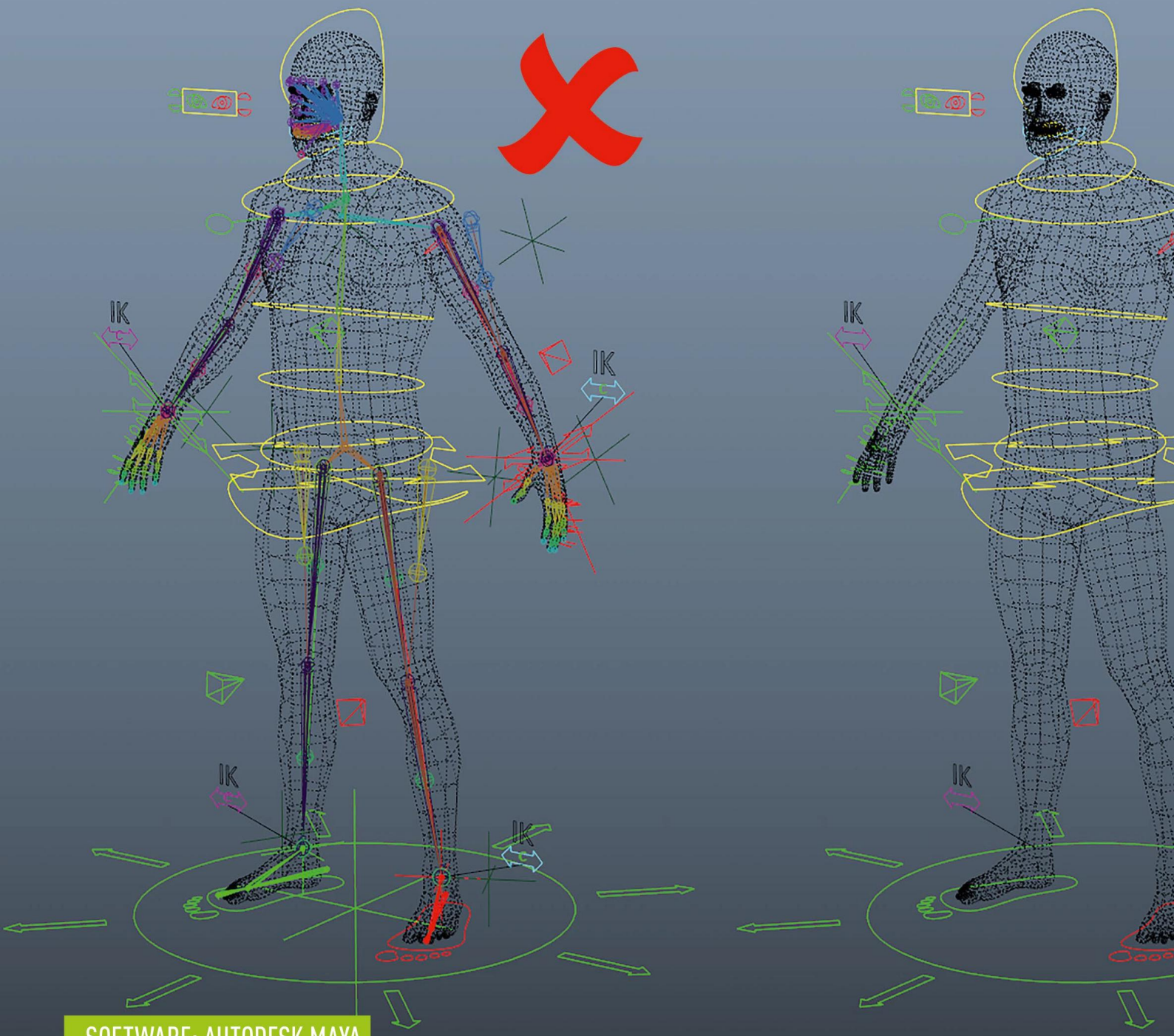
04

03 ACTIVATE MICROMESH

Merge the polygroups back together, then go to Geometry>Mesh Topology. Activate MicroMesh and from the pop-up menu select the premade scale. It will project the scale into the guide mesh. Hit the render button to see the result. If your scale is facing the wrong direction, you have the option to Spin Edge and Align Edge of the projection. You will find it right next to the MicroMesh button.

04 THE NEW GEOMETRY

When you are happy with the result, make sure you have BRP on, go to Geometry and just below the Divide button, you will find Convert BPR to Geo. This part of the process is not undoable, so make sure you save your project before you convert the mesh in case of further changes. Voilà! Now all you have to do is give it a texture or apply material.



SOFTWARE: AUTODESK MAYA

HOW DO I MAKE MY RIG ANIMATOR-PROOF?

Izzy Wood, *Chesterfield*



Antony Ward replies

Having the ability to construct complex systems that allow an animator to easily and intuitively bring a character to life is a true skill, and one which takes time to learn and master.

It's not just a case of adding IK and FK to a creature's limbs or producing a few blend shapes so they can emote. Rigging goes deeper than this, but the truth is all anyone will ever see are a series of colourful curves overlaid on top of a model. All the time spent developing systems, building node structures and

tweaking skin weights is hidden away, and so it should be. At the end of the day, it's our role as technical artists to create a rig which on the surface looks so easy to pick up and pose that a child could do it, while underneath the simplistic shapes actually lies a far more complex web of joints, ribbons and constraints.

It's these systems which are the driving force of the rig, and just like the engine of a car they need to be hidden away, shielded from the driver so they cannot be touched as its speeding down the motorway.

Something as simple as selecting and moving an IK handle or rotating an offset group could have drastic effects on the whole pipeline. A stray keyframe could lead to animation not being exported, it could also make the characters limbs move unpredictably, and controls shoot off into the distance. These are extreme cases, but I have seen them happen time and time again, with the result being a hit on the schedule as the rig is rebuilt.

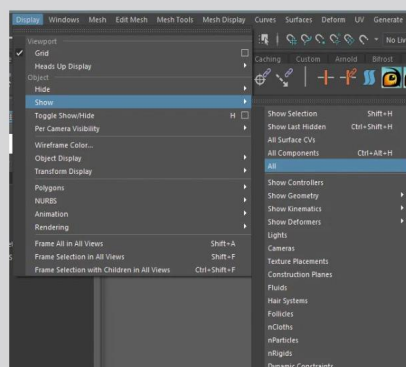
As unfortunate as this is, none of the blame lies with the animator. If the rig is

EXPERT TIP

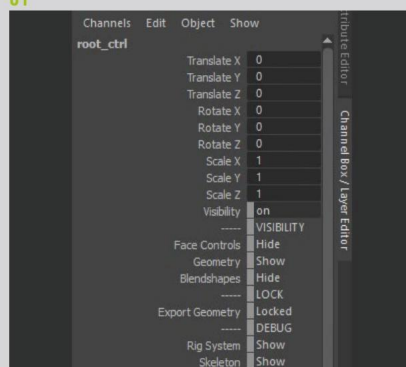
MAKE NODES UNDELETABLE

Another step you can take is to use the following bit of Python on each object: `cmds.lockNode("node name", lock=True)` – this will make that node undeletable, so someone can't accidentally delete a key part of the rig.

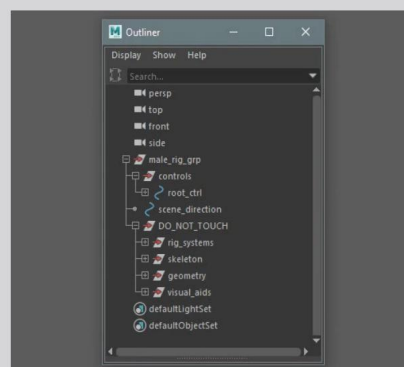
STEP BY STEP PROTECT YOUR RIGS!



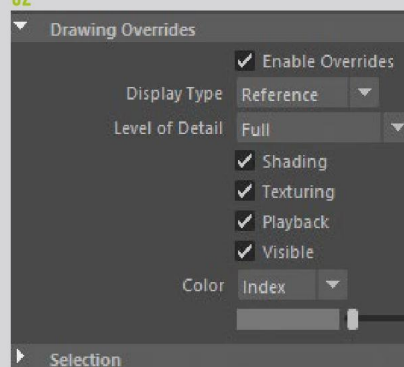
01



03



02



04

01 SHOW ALL

The first thing you need to do is go to Display>Show>All and see what you are working with. This simple step will be done by the animator on numerous occasions, so even if you've pressed Control and H and think you've hidden parts of the rig, they won't be. Any of the base systems that you can now see will need to be locked away.

02 CREATE A DO_NOT_TOUCH GROUP

A well-organised hierarchy is key to maintaining a clean rig, and taking the time to place things in the correct groups will also help when locking it down.

Make sure to keep important elements like rig systems, the skeleton, morph targets and main models in a DO_NOT_TOUCH group. This should make it clear that this group is not to be accessed by anyone.

03 VISIBILITY ATTRIBUTES

Somewhere on your rig you should have a series of attributes used to control which areas of the rig are visible. Connecting these to the visibility attributes on key groups, like the skeleton and rig systems, will lock their visibility to those attributes. This means Show>All will no longer make them visible, and they will remain safely locked away.

04 LOCK THE MODELS TOO

Another step you should take is to make sure the models are visible but not selectable. Again, a custom attribute with three options, Locked, Enabled and Wireframe, should be connected to each model's Display>Drawing Overrides>Display Type attribute. This will move between three states for you, the main being locked and unlocked. Also remember to make sure Enable Overrides is checked too.

Building a good rig is one thing, but if it's not correctly locked down it can easily be broken

not correctly locked down, then anything that's left visible and selectable is up for manipulation. It is not the animator's job to know what they can and cannot touch, they just want to pick up the rig and bring the character to life.

Therefore, it's important that before you hand over the rig, you've also taken the time to hide things away, locking attributes and organising the hierarchy.

So, what follows are a few things you can do to your rigs to make sure they are tamper-proof.

SOFTWARE: BLENDER

HOW CAN I CREATE A SAND MATERIAL USING BLENDER?

Sophie Riddle, London



Pietro Chiovaro replies

I will demonstrate an easy and powerful way to create a sand material using Blender. This scene is characterised by many elements, the lighting, the models, the reflections, the smoke simulation and obviously the materials, one of these is the sand material.

There are a lot of methods for creating a sand material – for example, using image texture – but in this article, I would like to explain how to create a sand material in a procedural way using nodes in Blender.

Before we start with the creation of the material, we have to create the mesh: in this case, I created a simple terrain with some dunes. Once we have done this, we can start.

First of all, we have to open the Node Editor panel and add the Texture Coordinate input, the Wave Texture, the ColorRamp (placed in the Converter section), the Hue Saturation Value (placed in the Color section), the Diffuse BSDF shader and obviously the Material Output.

These are the main elements of our material. Now we have to connect them and set the values.

We can start connecting the Texture Coordinate with the Wave Texture. If you have unwrapped the mesh, connect it with UV, if you haven't done this, connect it with generated, normal, object, camera, window or reflection. In the Wave Texture we have to enter a value of 18.000 in Scale, 14.000 in Distortion, 14.000 in Detail and 0.400 in Detail Scale. To give more realism to the material, connect the Color with the Displacement (in the Material Output). Now we have to connect the ColorRamp

with the Hue Saturation Value and connect the last one with the Diffuse BSDF.

In the ColorRamp we have to select the colours that we want for the sand material, in my case I used a mix of yellow and light pink. I fixed the colour using the Hue Saturation Value.

Next we can connect the BSDF of the Diffuse shader with Surface of the Material Output. And that's all! A simple and quick way to create a sand material like this, perfect for stylised projects.

As well as looking good and getting you up and running, hopefully this shows how easy it is to work with nodes.

EXPERT TIP

THE EASY WAY...

You can also create a sand material starting from a sand texture. You can create it using a photo editor software, taking a photo or downloading a texture – there are many sites that provide textures for free, and it's a great alternative to save time.



A revolutionary way to create a photorealistic material is with photogrammetry, which allows you to scan an environment to obtain accurate information for producing materials

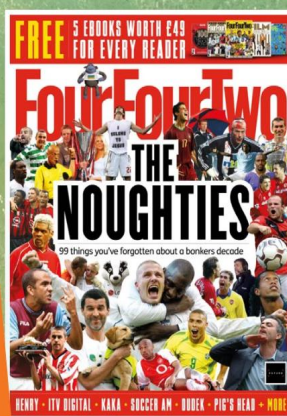


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CAVE RITUAL

Software Unreal Engine,
Maya, Substance Designer,
Substance Painter, ZBrush

Year made 2019



Technique focus

Incredible 3D artists take us behind their artwork



Dave Miragliotta

artstation.com/polycrunching

Dave Miragliotta has been working in the game industry for about 11 years and is currently a senior environment artist at Respawn Entertainment.

MODELLING I went with the modular approach when making the rocks for this scene. I was able to get a good variety with only a few different sculpts. When sculpting the rocks in ZBrush I made sure that each side had an interesting look to it. Leaving some sides simple looking with minimal detail allowed me to break up areas where it was getting too noisy. Also, I left out some details in the sculpt, like cracks which I added later using decals in Unreal. Because the rocks were being reused I didn't want any to stand out with too much distinguishing detail.



The Hub

News and views from around the international CG community



INDUSTRY INSIGHT

A new domain

25 years on, 3D World discovers how Digital Domain took VFX to new heights for Ron Howard's *Apollo 13*

In April 2020 NASA marked the 50th anniversary of its *Apollo 13* mission, and June 2020 marks the 25th anniversary of Ron Howard's Oscar-winning film of the same name. Originally released on 30 June 1995, the film remains one of the most celebrated movies to cover the space age and was lauded for its effects, created by a then fledgling Digital Domain. Kelly Port and Matthew Elliott Butler were involved in the production and remain at Digital

Domain to this day, now working as VFX supervisors. **3D World** caught up with the pair to hear their memories of working on the film.

Digital Domain utilised a groundbreaking combination of models, miniatures and CG animation to create the out-of-this-world visuals of *Apollo 13*, earning the team an Academy Award nomination. "I had no clue that we were pushing boundaries, nor defining them," Butler admits. "These were the times that you don't know you are in

until they're gone. We were all just kids, bootstrapping our existence and making things up as we went along."

"Because the team putting this all together had such an eclectic skill set, we couldn't help but learn through osmosis most of the time," Port reflects. "These were the days of film, so we would shoot some passes on a model on Tuesday and see the dailies the next morning. All the interested parties would be sitting in the screening room eager to see the film."



The team behind *Apollo 13* using models that would later be combined with state-of-the-art VFX



"IN THOSE DAYS, WE LEANED ON PRACTICAL EFFECTS QUITE A BIT. THE MINIATURE WORK WAS BREATHTAKING"

Kelly Port, VFX supervisor, Digital Domain

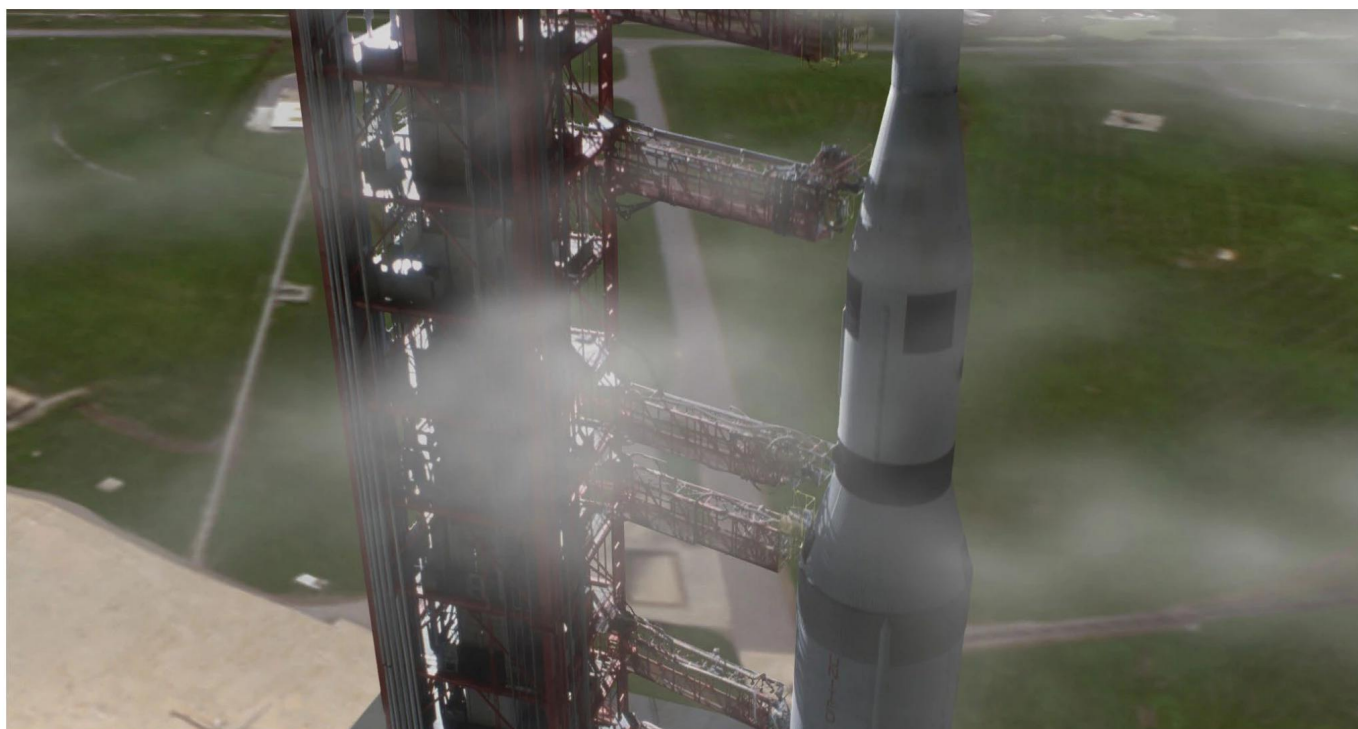
Among those reviewing the footage would be VFX supervisor Rob Legato and VFX DP Erik Nash, colour gurus like Price Pethel and Mike Kanfer, and the physical model makers. "It was in these morning dailies in the screening room that I just sat there like a sponge, absorbing as much technical and creative knowledge as I could," adds Port.

Even in its earliest days, Digital Domain was an eclectic environment that fostered creativity and experimentation. "No one had the same background, it was a mixture of

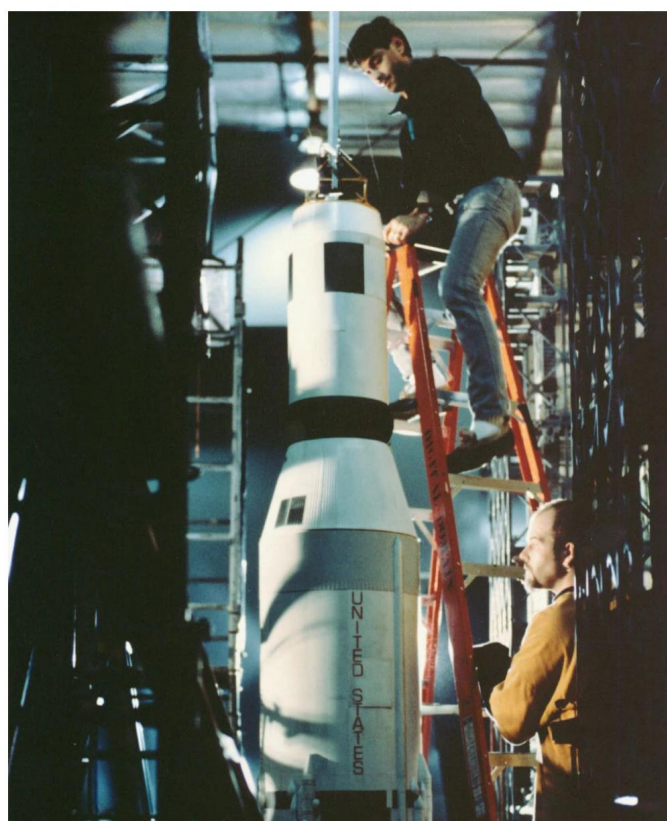
talented people from several disciplines in the arts and sciences," says Butler. "It was problem solving in the extreme – fearless and scary." This feeling was bolstered by the relative lack of infrastructure at the time. "This was back when we were running rogue," he adds, "but needed to be more systematic as we scaled up."

Many of *Apollo 13*'s most impressive shots were achieved by combining practical and digital effects. "Back then there was no differentiation," Butler recalls. "In fact,

fully synthesised shots were really scary, and leaning on practical photography was a necessity. The more practical photography the better. I feel differently now." Port adds: "In those days, digital effects simply didn't hold up, so we leaned on practical effects quite a bit. The miniature work on *Apollo 13* was breathtaking. We had to run a good number of motion control passes, all shot on film, which had to be scanned, and then aligned with one another to match at the pixel level." ➤



Above: On the film's release, audiences assumed that the rocket launch scene was historical footage; it was actually a series of miniature shots by Digital Domain





Along with *True Lies* and *Interview With The Vampire*, *Apollo 13* was among the first feature films that Digital Domain worked on



"DIGITAL DOMAIN'S WORK ON APOLLO 13 WAS SO BELIEVABLE, PEOPLE DIDN'T REALISE THAT IT WASN'T STOCK FOOTAGE"

Matthew Elliott Butler, VFX supervisor, Digital Domain

➤ The cultural and historical importance of *Apollo 13* meant that realism was crucial to the film's success. Butler believes that the accuracy of Digital Domain's effects worked to their detriment when it came to awards season. "I remember watching the 1996 Academy Awards and being astonished that *Apollo 13* got pipped by *Babe*, the talking pig," he admits. "The team behind *Babe* did an amazing job, but Digital Domain's work on *Apollo 13* was so believable that people didn't realise that it wasn't stock footage."

"For the most part, both Rob Legato and director Ron Howard re-created shots that felt as if they could be stock footage," Port recalls. "We wanted people to think that it was stock footage. In fact, one of the astronauts said something to that effect after the film was released."

Apollo 13 would prove to be a landmark film in the development of VFX, utilising many state-of-the-art techniques to achieve its realistic visuals. For Butler the simulation software used by Digital Domain is a particular point of pride. "This was the first time that I saw physics simulated

realistically in a photorealistic manner," he says, "it was so believable."

One of Port's tasks during production was to create a procedural system that controlled the visuals of the directional thrusters the pilots used to manoeuvre around. "The rotations were done at the motion control stage," he explains, "and once that film was scanned, and based on the rotations and if they were accelerating, I would turn on the digital thrusters. It was a very simple thing, but it made me feel like a genius."

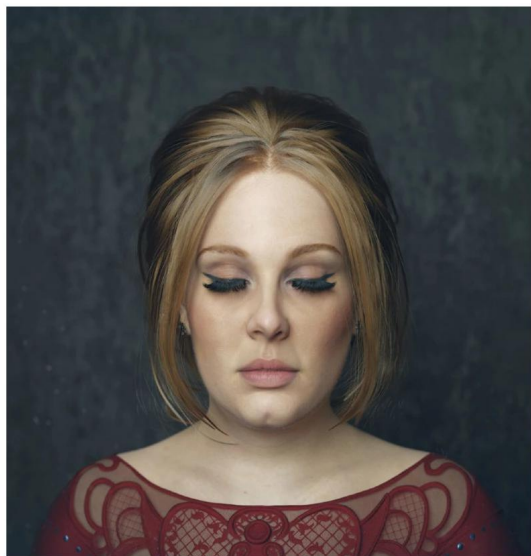
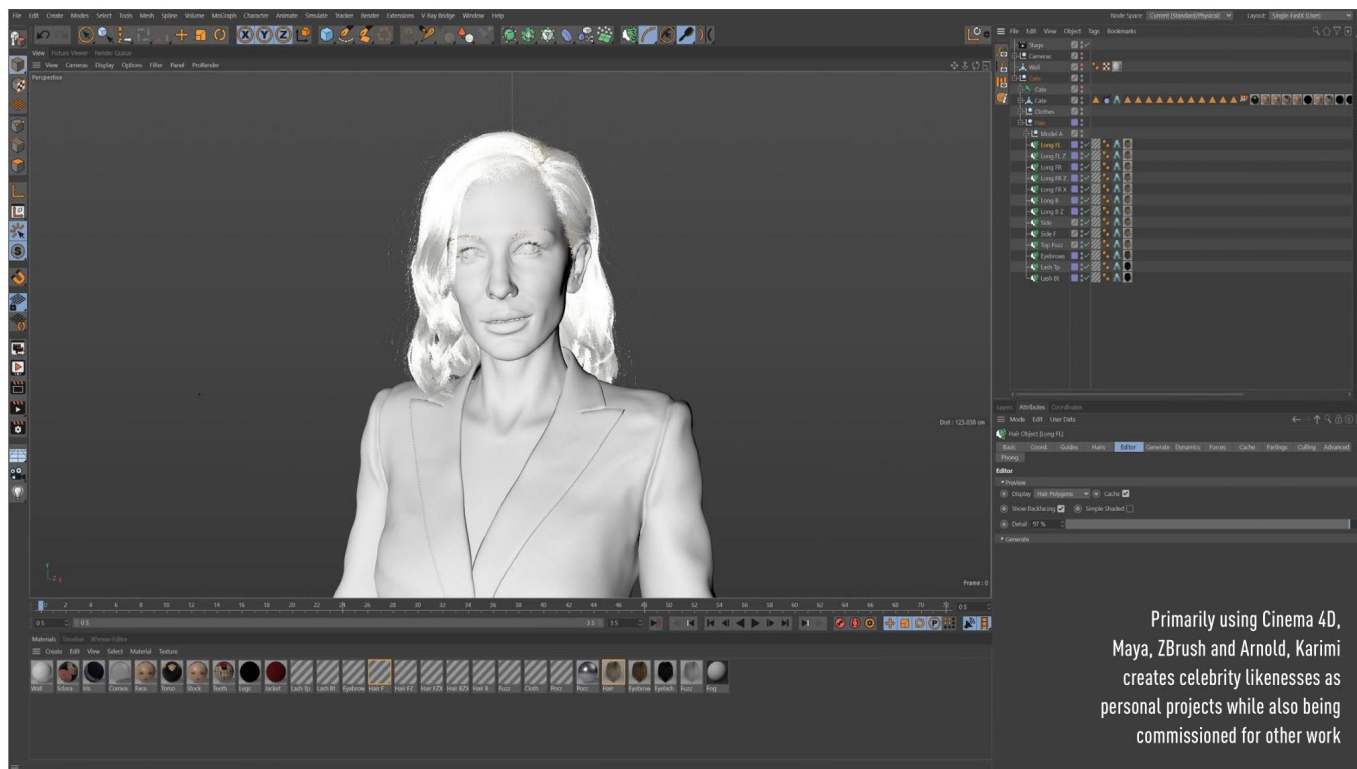
The landscape of VFX is ever-changing and has evolved dramatically since Digital Domain's work on *Apollo 13*, as Butler reflects: "It used to be about, 'how can we solve this?', now it's more about, 'how can we approximate this affordably?'" Port explains that the approach to using miniatures has changed fundamentally since 1994: "At that time we took advantage of miniature models in a very big way. Digital models were good, but hadn't yet evolved to the photorealistic quality you often see today. Since that time, miniature photography has sadly been used much less frequently in productions."

THE TOOLSET

Kelly Port and Matthew Elliott Butler discuss the tools they used to send *Apollo 13* into space

In order to execute Ron Howard's vision for *Apollo 13*, the team at Digital Domain had to embrace the most advanced tools and software available at the time. "For me it was SideFX's Prisms, the precursor to Houdini," explains Matthew Elliott Butler. "I was an artist trained as an engineer. I saw an application that allowed artists to open the hood and exploit their abilities to combine skill sets between the disciplines. I wasn't running Prisms myself, but I was amazed at what these talented artists could achieve."

Fellow Digital Domain team member Kelly Port used Prisms alongside the compositing software, Nuke, which was originally written at Digital Domain by Bill Spitzak. "Nuke was still in its early days, but it was our core software," Port recalls. "Digital Domain became very well known for their strong compositing because of people like Bill and the team that was developing it. As of today, it is far and away the standard compositing tool for the industry."





MEDIA INSIGHT

Sculpting celebrities

Discover CG artist Hadi Karimi's striking
3D celebrity likenesses

By Meleah Maynard



artist Hadi Karimi (hadikarimi.com) has been creating remarkably photoreal 3D likenesses of celebrities for years, including the likes of

Adele, Taylor Swift, Amy Winehouse, Drake and Freddie Mercury, among others. Karimi started out doing 2D digital painting, video editing, logo design and other work, before eventually moving into the field of 3D. Based in Tehran, Iran, he is now increasingly becoming known for the realistic likenesses he creates, primarily using Cinema 4D, Maya, ZBrush and Arnold. Read on to find out more about Karimi's work, career and his inspirations.

Tell me about yourself and your work. Did you study anatomy or art or both?

When I was a kid, I used to draw a lot, all sorts of different subjects like portraits, animals and even cars and architecture. Unfortunately, I've never been to art school. I didn't have enough motivation to convince the people around me, or even myself, that I could make a living out of my passion. After wasting a couple of years in college, I made up my mind and started to take things a little bit more seriously. But I'm struggling to find my way into the industry, mostly because of the difficulties caused by politics. It's hard to have a reliable career in art where I live.

What are the 3D/CG artist communities like there?

The CG communities here are mostly for architectures, which I admire, but that's not something I'm personally interested in. If there are any communities for 3D character artists, I'm not aware of them. As I said, this is not the best place in the world to have a career in CG, or even art in general. There are so many difficulties that

"MOST OF THE TIME
MY SUBJECTS HAVE
HAD AN IMPACT ON MY
LIFE OR CAREER"

artists, particularly freelancers, have to face because of the economic sanctions.

For example, a few months back I had a commission from one of the well-known video game studios, but after I sent them my information for the contract, they responded that they couldn't work with me due to the sanctions. If that's not frustrating, then I don't know what is! These boundaries are not new for us, but things have gotten worse recently for sure. Being an artist here has been hard for as long as I can remember.

What do you do to earn a living?

Currently, I'm working as a freelance programmer. Art has always been more of a passion than a profession for me because of the difficulties freelance artists have to deal with here. All of the portraits that I have shared so far are personal projects. I think I'm more interested in likeness portraits as personal projects, and commissioned work is more modelling different sorts of characters, like animals or creatures or generic faces. Recently, for example, I worked for a client who commissioned me to sculpt a bust. They already had a concept in mind and wanted it to be 3D printed.

Do your clients mostly find you because of your personal work?

Yes, mostly clients come across my portfolio on ArtStation (artstation.com/hadikarimi) and Instagram. Art communities have been very kind to me. They have featured my work on so many occasions to let more people, and potential clients, see it and get in touch with me. Social media is a great opportunity for artists to spread their messages and let studios find new talent. (See Karimi working on his Amy Winehouse likeness in C4D here: bit.ly/37iP8Wb).

When did you start using Cinema 4D, and how do you use it in your work?

Cinema 4D was the first 3D software that I started to learn without feeling

➤ overwhelmed. I was so fascinated by how intuitive and easy it was to learn. Many of my recent portraits have been rendered in C4D but, as a character artist, most of my commissions require that I work in Maya.

So, what is your workflow for creating these celebrity likenesses?

I start by studying references and, since they are celebrities, there are endless numbers of images online. I search for references with different angles and lighting. Then, I begin sculpting the base in ZBrush before transferring the model to either Cinema 4D or Maya, depending on the project, so I can add hair and materials and then render it. I mostly use Arnold for rendering because of its capabilities. (Watch Karimi rigging Adele's likeness in Cinema 4D here: [bit.ly/3fA6WPG](#)).

You recently did a likeness of the philosopher Friedrich Nietzsche. How do you choose your subjects?

It's not like I always take a lot into consideration when I pick a new subject. Sometimes I just want to challenge myself to catch a likeness that is kind of new to my eyes. But most of the time my subjects are those who have had an impact on my life or career. This year I'm going to sculpt some other philosophers and historical figures.

What do you find most difficult when you're working on these?

Hair is sometimes a pain, but it's usually the most enjoyable part of the process. The challenging part for me has always been getting the likeness itself right. Sometimes it only takes me an hour to get someone's face right, but other times it can take weeks. It

varies from subject to subject and it's hard to say why. Most of the time when I'm working on a likeness, I feel like there's something missing, even if others compliment it. Our faces are full of different expressions and subtle details, so figuring out that missing link mostly just comes from experience.

What kinds of commissioned work would you most like to get in the future?

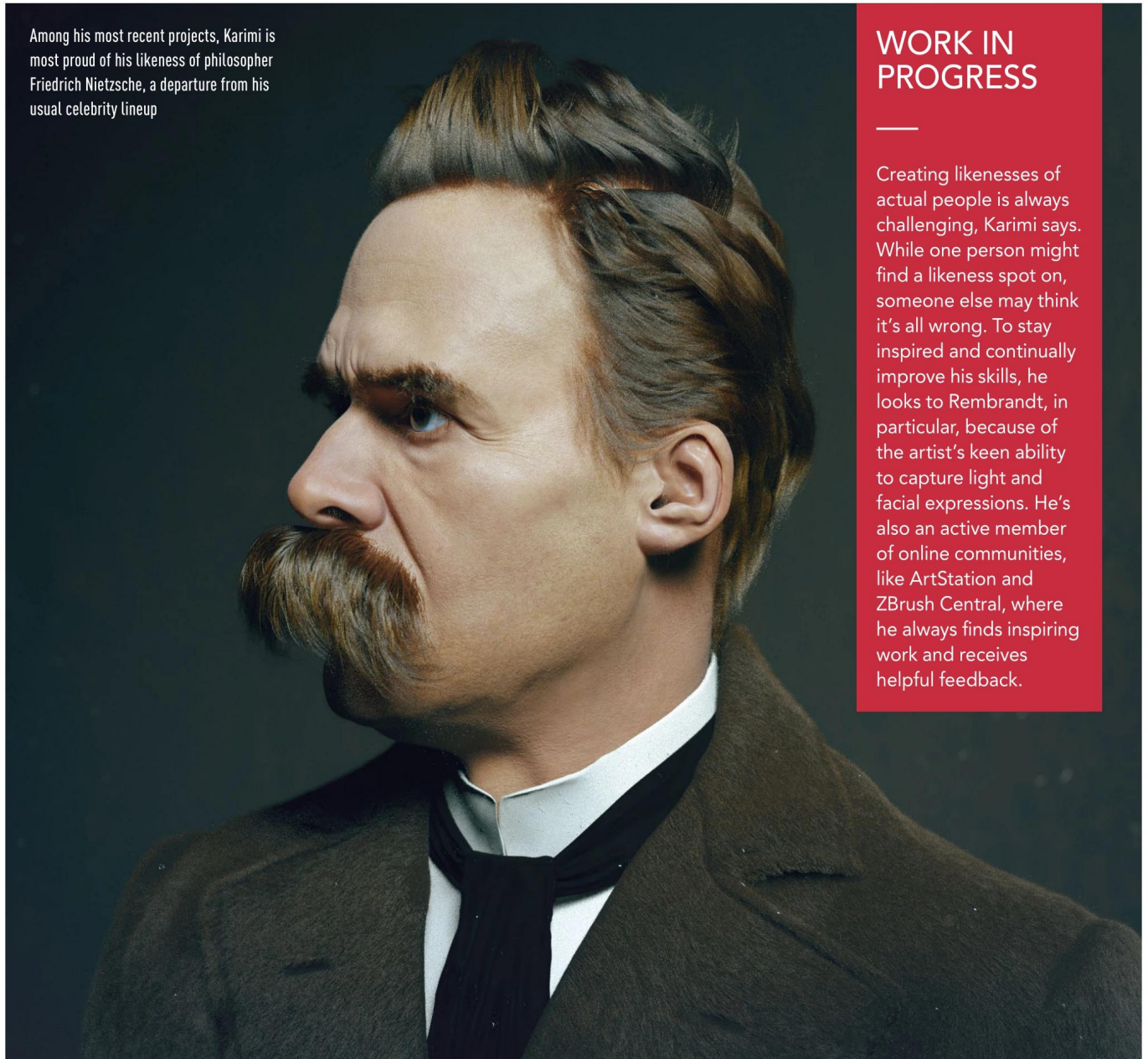
I'd really love to create the main character of a video game someday. Making realistic faces for movies and commercials would also be great but, to me, there's something about video games that helps the character work stand out.

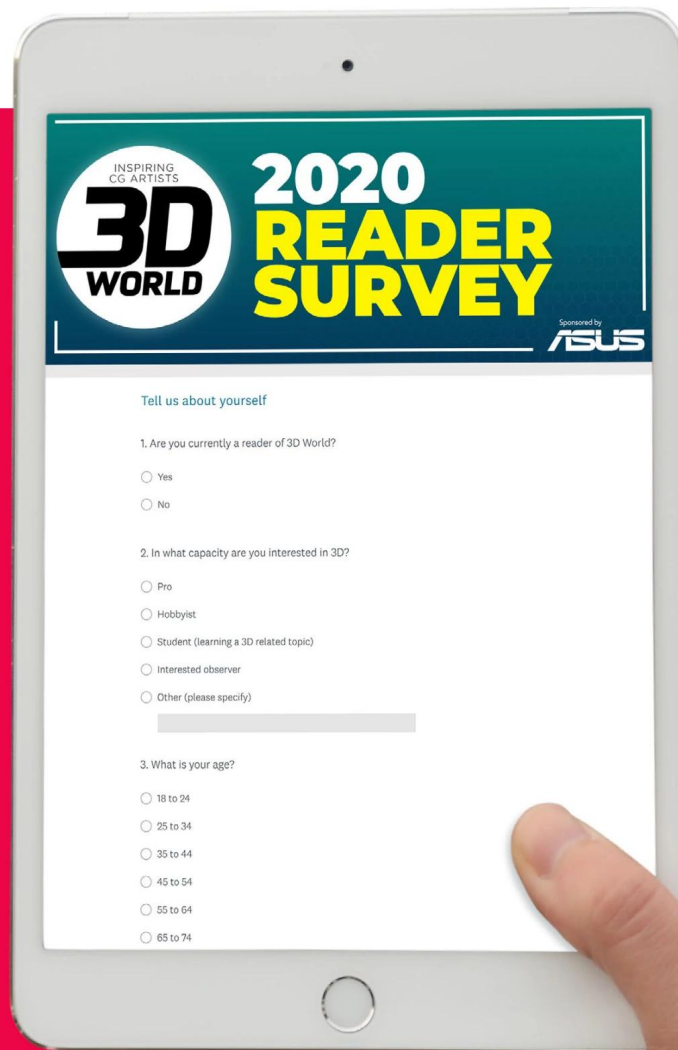
Meleah Maynard is a writer and editor based in Minneapolis, Minnesota.

Among his most recent projects, Karimi is most proud of his likeness of philosopher Friedrich Nietzsche, a departure from his usual celebrity lineup

WORK IN PROGRESS

Creating likenesses of actual people is always challenging, Karimi says. While one person might find a likeness spot on, someone else may think it's all wrong. To stay inspired and continually improve his skills, he looks to Rembrandt, in particular, because of the artist's keen ability to capture light and facial expressions. He's also an active member of online communities, like ArtStation and ZBrush Central, where he always finds inspiring work and receives helpful feedback.





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We love **3D World** but we know that there may be things you'd like to see more of, or see done differently, so please take part in the survey and let us know what you want. At the end of the day this is your mag, and we want to make it as good as it can possibly be.

Rob

Rob Redman, Editor
rob.redman@futurenet.com





MEDIA INSIGHT

Mediatonic's guide to growing a creative games company

Murder By Numbers game director Ed Fear talks how Mediatonic strives to push boundaries with every new project

Okay, so we'll admit it – until recently, you might not have heard of Mediatonic. But the truth is, we've been quietly growing into one of the UK's biggest independent game developers – now with over 230 people across four studios in London, Brighton, Leamington Spa and sunny Madrid.

Platform-agnostic, our games range from top-grossing mobile titles like *Yahtzee With Buddies* to upcoming PC/console party-royale *Fall Guys: Ultimate Knockout*. What's inspired us and challenged us has led us down a weird and wonderful path that we're glad to have pursued.

Over those past 14 years, we've learned a few things and are eager to share our advice, so here are our thoughts on setting out your stall as a studio and what you can do to grow it sustainably.

GAMES YOU NEVER KNEW YOU WANTED

There are countless studios in the world that can make games – and more with each day that passes – so it's important to work out what makes you stand out: what makes you special and what ingredient you can put in that no-one else can.

We spent a lot of time thinking about what makes a Mediatonic game: what DNA threads our early offbeat titles like *Amateur Surgeon* together with what we're currently working on at the moment. And the best answer we've come up with is that there's always a twist – something a little different from the norm.

"Wait," you're probably thinking. "You just said we need to find the difference, but your difference is that you're different?"

Well, yeah. Game budgets everywhere are increasing, and with that increase comes an intense aversion to risk. At the same

time, with mobile gaming reaching billions of people who traditionally wouldn't have described themselves as 'gamers', the desire to reach the widest possible audience has led to an intense blandification of games. Everything is focus-tested to appeal to the widest possible demographic, and anything that has the slightest chance of causing a negative reaction, no matter how small, is avoided like the plague.

That's not how we do things at Mediatonic. First and foremost, we're players of games, and we want to make things that surprise people, things that catch them unguarded. Things they never knew they wanted. Things that stand out from the thousands of games released every month by virtue of what they are.

It might be an unusual combination of game mechanics, like making a narrative-driven Picross-style game by



infusing detective elements. It might be a thematic twist: for example, our upcoming multiplayer party game *Fall Guys: Ultimate Knockout* is a non-violent take on the popular battle-royale genre, replacing guns and grit with gameshow assault courses in the style of classic TV show *Takeshi's Castle*. Or it might be a unique visual treatment – mixing the worlds of the ultraviolet *Gears Of War* with the adorable cuteness of Funko Pops in our mobile title *Gears POP!* (trust us, the first time you see a Funko Pop slice another's head off with a gun-chainsaw hybrid is something you won't forget.)

As a bonus, this also helps us attract talent. In many of the cities and towns that we have studios in, there are countless other developers that people could work at. We want our games to be what helps make that choice for people: that they can only do this here.

SOLVING THE MYSTERY OF GAME DEVELOPMENT

Murder By Numbers is a good example of Mediatonic's holistic approach to 'difference'. It starts with a gameplay concept that had never been done before: nonogram logic puzzles (think Sudoku, except you're filling in a grid with shaded squares rather than numbers, in order to make pixel art), combined with a detective visual novel.

When it came to the visuals too, we wanted to find our difference. If you've ever played a visual novel – traditionally a Japanese genre – they all tend to look quite similar: two characters, a backdrop and a text box. It can sometimes be hard to tell one from another. We had a goal of ensuring that if you saw a screenshot of *Murder By Numbers* amongst other VNs, you'd know which was ours instantly.

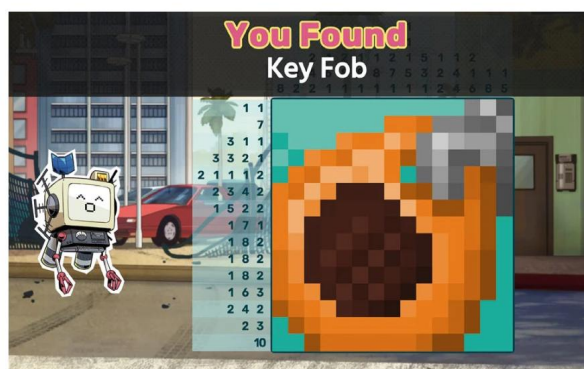
We chose a bright, poppy colour palette. We enlisted the help of Hato Moa, creator of *Hatoful Boyfriend*, to design our characters, and fuse her anime sensibilities with a shading style reminiscent of American comics. And we set the game in the 90s, so that we could play with the garish clashing fashions of the times.

The setting – a Hollywood actress turned amateur detective, complete with robot sidekick buddy – again has a strong element of difference about it, while still evoking the high-concept madness of 90s TV shows. And we set one of the cases in a drag club, not for token inclusivity, but because we thought it would be fun.

All of these differences combine to make a game with a unique style, a fresh atmosphere, and a clear distinction from the competition. And that is what makes a Mediatonic game.



Above: *Murder By Numbers'* wonderfully quirky cast of characters were designed by Hato Moa, known for the popular Japanese visual novel/dating simulator *Hatoful Boyfriend*





MIRACLE GROW FOR GAMES

We often get asked how we grew from a studio founded as a side-hustle for two university students into the company we are today, and the answer's actually fairly simple: by pushing our boundaries a little further with each project, we've been able to grow in capability and become a studio that can take on a huge variety of projects.

It started with games that could be made by a few people: simple Flash web games that kept people coming back, and that built up our reputation with the countless game portal websites around in the late 00s. From there, we expanded our horizons to create connected experiences: games that used servers to store data and facilitate interactions between players.

We were able to work on games that became incredibly popular and that pushed us to develop much of the strong server technology base that serves us so well today, delivering content to millions of users and customising it by market. That enabled us to work with Square Enix Japan on *Heavenstrike Rivals*, an original mobile PVP battler, where we learned how to deliver multiple content updates a week and release over 900 fully animated units in three years

"FIND YOUR STYLE, DON'T BE AFRAID TO TAKE RISKS IN BEING CREATIVE, AND PUSH YOURSELF INTO NEW TERRITORIES"

– helping cement our processes for operating live service games. That, in turn, led to us working on some of the most popular mobile games and biggest licences in the world.

Our focus in recent years has been taking that experience and pushing it even further into new avenues and new markets and new original titles. *Fall Guys*, for instance, is a natural progression of our server technology into large-scale simultaneous multiplayer games. *Murder By Numbers* builds upon our experience writing countless mystery stories for the *Fantastic Beasts: Cases From The Wizarding World*, but putting it into a 'complete package' with an overarching story, and *Gears POP!* builds on all our experiences working with huge IP to bring two quite diverse brands together in a unique and exciting way. By building on our experience and pushing ourselves beyond

our comfort zones, we've been able to grow from 2 people to 230 and we're excited about what the future holds.

THAT'S A WRAP

It's not easy finding your path and then building on it – if it was, everyone would do it. But we think if you find your style, don't be afraid to take risks in being creative, and push yourself into new territories while building upon your successes, you'll build a brand and a company that can withstand the test of time. Good luck!



Ed Fear - Senior creative designer

Joined Mediatonic back in 2012 when things were a lot smaller than they are now. He most recently directed and co-wrote the critically-acclaimed *Murder By Numbers*, out now on Switch and PC.



A DAY IN THE LIFE OF...

Antony Ward

We chat to the experienced artist about life as a freelance generalist



NAME
Antony Ward

JOB TITLE
Creative Director

STUDIO
antCGi Limited

LOCATION
UK

ABOUT
Be it game development, rigging or writing/recording in-depth courses, Antony Ward has experience in most areas of 3D.

WEB
www.antcgi.com

Regular contributor to 3D World, Antony Ward, is an industry veteran with decades of experience, having worked for top VFX studios as well as writing in-depth manuals and guides on a variety of fields. We asked him to share how he spends a typical day.

How do you get started and set yourself up for the day ahead?

My day usually begins at around 7:30am, that's when the rest of the house is up so it makes sense to dive right in. Plus, I find these initial golden hours very productive, because it's before my clients start work, so I can focus on other things.

I use this time for planning my day's schedule, replying to emails and the comments on my YouTube channel. I also use this period to do some painting. Even though I work primarily in 3D, I want to keep on top of my traditional art skills too and this time gives me the opportunity to do that.

Can you describe your role as a freelance generalist?

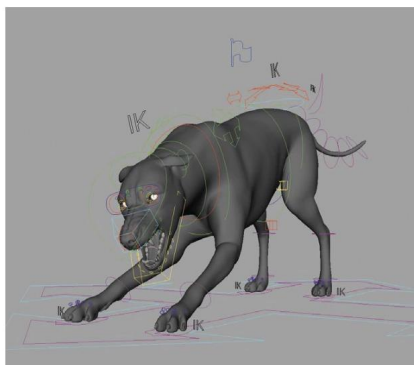
With my career starting so long ago, before people had specific roles, we were expected, as artists, to be able to do a bit of everything. So, I learned modelling, texturing, rigging and even animation. I found in the long run it made me a more valuable team member because when one project finished, I was

able to jump onto another, no matter what was needed.

I find that being a generalist also helps when being freelance. Again, because I have experience in all these areas it means I have more options when it comes to looking for new contracts.

What kind of day-to-day challenges do you face as a freelance generalist?

When you freelance every day is a challenge. Even if you're busy you are always thinking ahead to when that contract ends and what you will do next. So, as well as doing your client work you are also keeping on top of your social media presence, updating your portfolio and reaching out to other potential



clients. All this while maintaining the quality of your work, so it's a lot to juggle.

It's good to be focused and plan times for doing certain things, rather than get distracted with one and sacrifice time.

What's the best thing about your role?

I love the freedom that comes with being freelance. I can usually work the hours that suit me, and I can also come and go as I please without having to clear it with a manager. This has enabled me to spend more time with my kids, which is priceless.

I also like being able to choose the type of work I do; one month I'll be animating, the next building rigs. I think it's the variety which keeps me enjoying it. Since going freelance I've been able to work on some amazing projects, while also expanding my area of expertise outside games and into visual effects.

How do you typically end the day? What needs to be done before you can leave? And how do you unwind from a day of creativity?

I always have an idea in my head of what I need to accomplish that day, so I make

sure I achieve that before I finish.

When working from home it's important to have a separate space to work in so once I'm finished for the day, I close the door and that's it.

As for unwinding, I do the usual. I go to the gym to stay healthy and socialise with my family and friends. When you work from home it's easy to get into a routine where you don't see other people, so it's good to make the effort and maintain those connections. I also play a lot of games; it's all research after all!

What kind of work do you do outside of your day job and why?

I find that my job is all encompassing, so it's lucky that it's my hobby too. As far as other work goes, I guess recording tutorials for my YouTube channel has become like a second job with the amount of time each video takes. The feedback I get from my subscribers really pushes me to keep creating, so I try and upload as often as I can.

I've also found a renewed passion for drawing and painting. Just digitally at the moment, but I might go analogue at some point in the future.

GOING FREELANCE

Antony shares how he got started as a freelancer, and offers his advice

How did you become a freelance generalist?

After spending 14 years working in various game studios, I decided that I wanted to try going it alone. Luckily, I was working at Sumo Digital at the time and they fully supported my decision and gave me the option to return if it didn't work out. 13 years later I'm still going strong.

What skills and qualities are essential to being a freelance generalist?

You need to be focused and dedicated to your work. If you're at home, it's easy to get distracted with other things. You also need to be constantly learning new techniques to improve your own skills, which from a client's perspective, makes you a better person to hire.

What advice can you give to artists that may want to become a generalist at a studio?

Even if you're employed with a certain role, take time to dive into other areas. For example, I find having a good knowledge of animation makes you better at building rigs. Knowing how to rig lends itself to making you better at building models. So, nothing is wasted, it also makes you more valuable.

Do you have any advice for going freelance?

Make sure you have a good number of in-house years under your belt. Knowing the intricacies of how a studio works will make you more aware when you're working remotely. Plus, it will give your clients more confidence in your work.

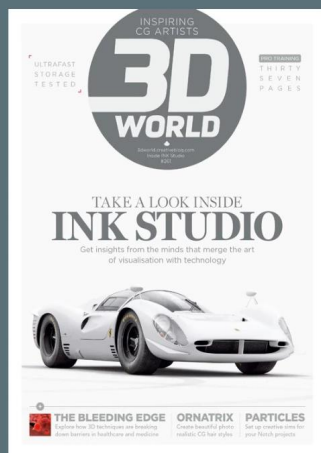
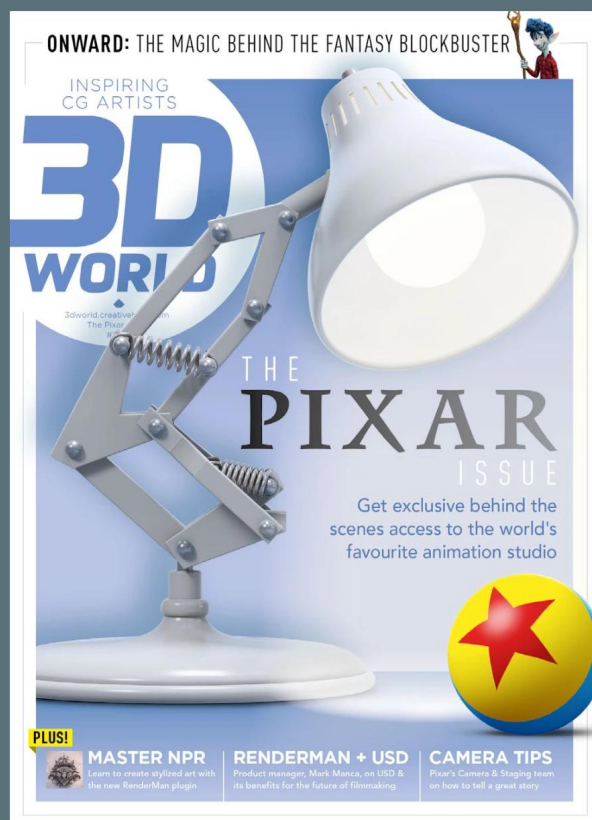


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MASTER CHARACTERS

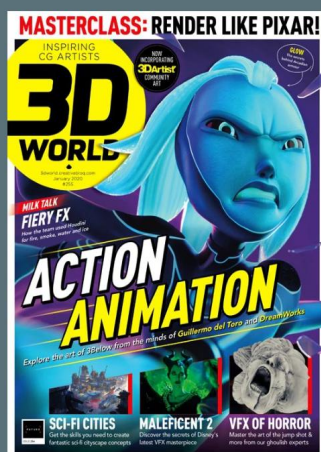
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- Create stunning steampunk art
- Behind the scenes of DreamWorks Animation's *Abominable*
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POWER UP YOUR CG SKILLS

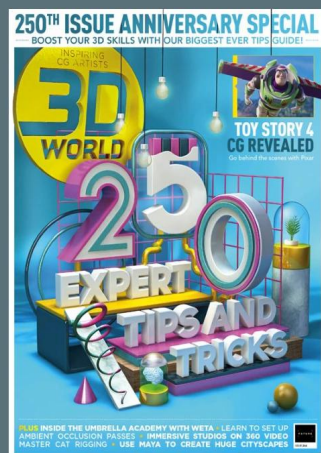
- Find out how artists can utilise social media to build their brand
- The making of *Stranger Things*' gruesome Mind Flayer
- Scanline VFX talk *Game Of Thrones*' destructive dragons
- Inside Milk VFX Part 2, this issue focusing on character animation
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THE STATE OF VR: THE LATEST TOOLS, TIPS AND TECHNIQUES

- Discover the revolutionary impact of virtual reality technology
- The first part in a new series exploring Milk VFX's work on major TV shows and films
- Enhance your imagery with our expert compositing tips
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250TH ISSUE ANNIVERSARY SPECIAL

- 250 expert tips and tricks in celebration of our big milestone
- Artists from the likes of Pixar and Ziva take a look back at the growth of the industry over the last two decades
- Discover the CG artistry behind *Toy Story 4*
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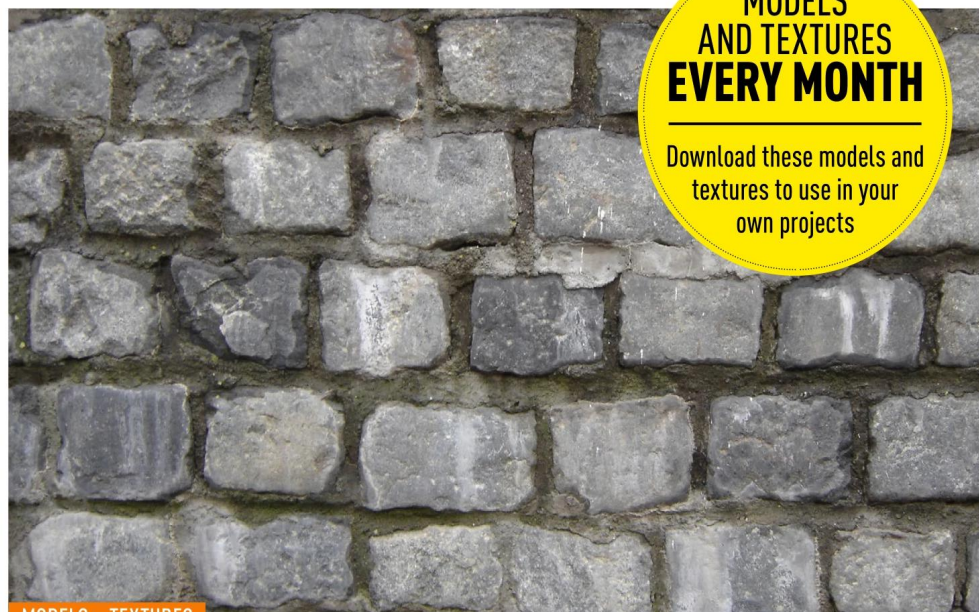
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Matthew Novak runs you, step by step, through the process of making photoreal blueberry shaders.

ISSUE 264



NEXT MONTH

Next issue, we explore the cutting-edge VFX of the music video

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